

5G Channel Model – Pathloss File Input

Software Recommended: NetSim Standard v13.0 (32-bit/ 64-bit), Visual Studio 2017/2019

Project Download Link:

https://github.com/NetSim-TETCOS/5G_LTE_Pathloss_Input_v13.0/archive/refs/heads/main.zip

Follow the instructions specified in the following link to download and setup the Project in NetSim:

<https://support.tetcos.com/en/support/solutions/articles/14000128666-downloading-and-setting-up-netsim-file-exchange-projects>

Features

Using this workspace users can

- Vary the 5G channel model in NetSim
- Input a pathloss file for each gNB in the network. NetSim would read the pathloss text file for the gNB in the network and use it to identify best server and for signal strength calculations.

Code Modifications

Open the source codes in Visual Studio by going to Your Work -> Workspace Options and clicking on the Open Code button.

In LTE_NR.c file function for reading and opening the input pathloss file has been called

```
static bool isLTENRTraceConfigured = false;
static bool isCalledOnce = false;
//Function prototype
int fn_NetSim_LTE_NR_Init_F();
int fn_NetSim_LTE_NR_Configure_F(void** var);
int fn_NetSim_LTE_NR_Finish_F();
#pragma endregion

#pragma region LTENR_INIT
_declspec(dllexport) int fn_NetSim_LTE_NR_Init()
{
    if (!isCalledOnce)
    {
        FileBasedPathlossWritingFile();
        FileBasedpathlossReadingFile();
        isCalledOnce = true;
    }
}
```

```

    return fn_NetSim_LTE_NR_Init_F();
}

```

In LTENR_Propagation_Model.c the below highlighted edits

```

static double calculate_pathloss_only(ptrLTENR_PROPAGATIONINFO info)
{
    if (pathlossInfo[info->gnbld - 1])
    {
        return fn_netsim_get_pathloss_from_file(info->gnbld, info->ueid);
    }
    double fc = info->frequency_gHz;
    double PL1, PL2, PL3, distance2D, distance3D, distanceBP;
    double pathloss_RMa_LOS = 0, pathloss_RMa_NLOS = 0;
    double pathloss_UMa_LOS = 0, pathloss_UMa_NLOS = 0;
    double pathloss_UMi_LOS = 0, pathloss_UMi_NLOS = 0;
    double pathloss_InH_LOS = 0, pathloss_InH_NLOS = 0;

    double hBS, hUT, W, h;
    double h_effectiveEnv, hBS_effective, hUT_effective;

    distance2D = info->dist2D;
    distance3D = info->dist3D;

    LTENR_LOS_NLOS_STATE state = info->propagationConfig->state;

```

The ReadPathlossInput.c file contains the following functions:

```

1  #include "main.h"
2  #include "LTE_NR.h"
3  #include "LTENR_PHY.h"
4  #include "NetSim_utility.h"
5
6
7
8
9  /** This function is to free the file pointers */
10 int FileBasedpathlossPointersFree() { ... }
24 /** This function is to to open the path where user can place the pathloss file for a GNB */
25 int FileBasedPathlossWritingFile() { ... }
36
37
38 /** This function is to open the file, and identify the pathloss for a receiver */
39 int FileBasedpathlossReadingFile() { ... }
162
163 double fn_netsim_get_pathloss_from_file(int gnbld, int ueid) { ... }
228

```

FileBasedpathlossReadingFile()

Reads the pathloss file given by user and stores the coordinates and pathloss values for each gNB in a separate list.

fn_netsim_get_pathloss_from_file()

Returns the pathloss at a requested receiver coordinate with respect to the transmitter gNB.

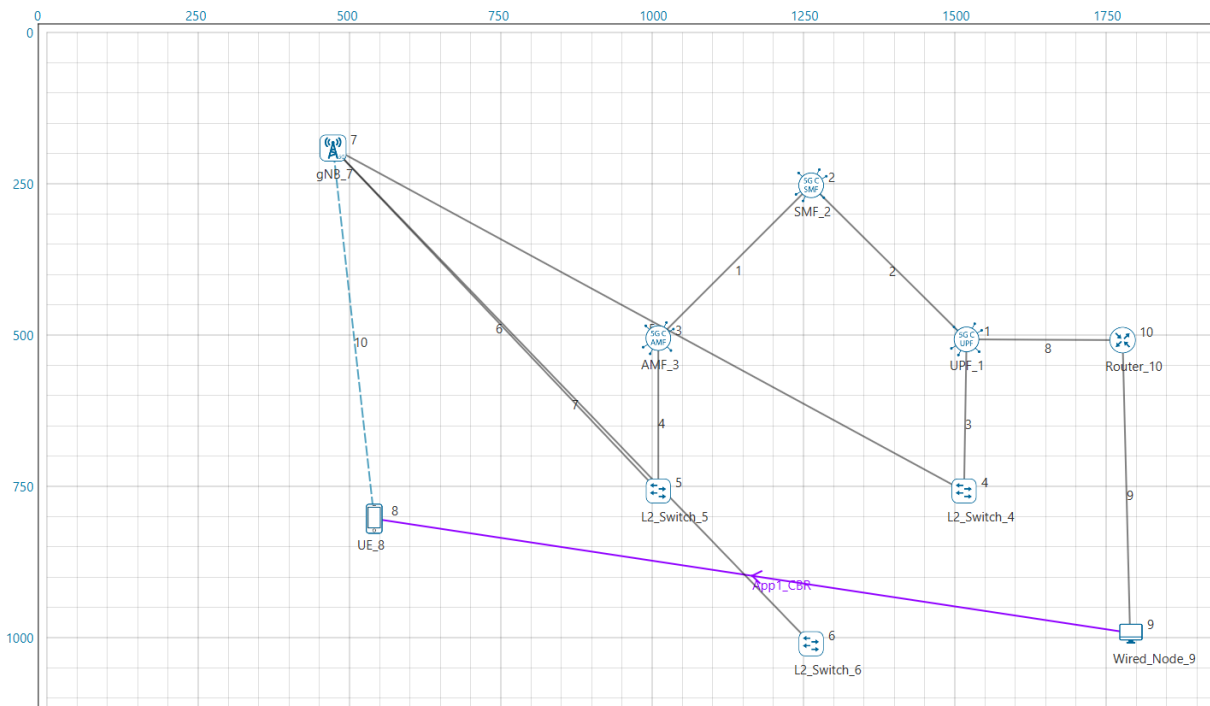
FileBasedPathlossWritingFile()

This function is to open the path where user can place the pathloss file for a GNB.

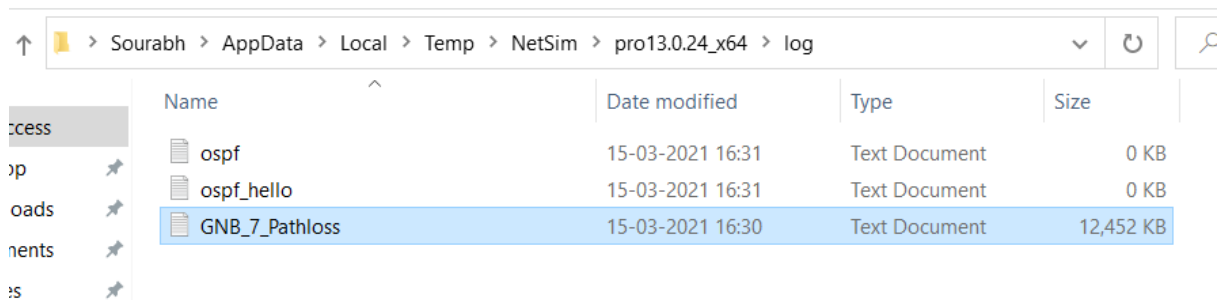
Example

The below scenario

- Consists of 1 gNB and 1 UE. An external pathloss file is given as input to the gNB. This will override whatever channel model is set via the GUI.
- Users should pay attention to the gNB's co-ordinates. It is *not* part of the pathloss file, and is set via the GUI (X, Y co-ordinates). Take care that the gNB co-ordinates match (or is suitably transformed) the co-ordinates used for generating the pathloss file
- The network is simulated for 60 s with application generation rate as 23 Mbps.



Upon clicking the RUN button, the log folder path is automatically opened. User should place the files containing the pathloss for eNB/Gnb's in the network here:



The pathloss file should start with the device name followed by “_Pathloss” and be saved as a text file (*.txt).

The pathloss file should be per the given format:

The first two lines must have the below parameters

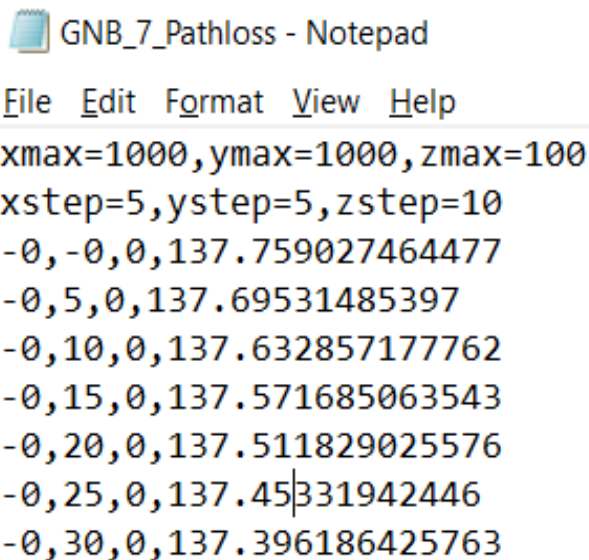
```
xmax=1000,ymax=1000,zmax=100
```

```
xstep=5,ystep=5,zstep=10
```

Subsequently, x, y, z coordinates with pathloss value must be given.

```
x_cordinate (m),y_cordinate (m),z_cordinate (m),pathloss (dB)
```

An example screen shot is provided below

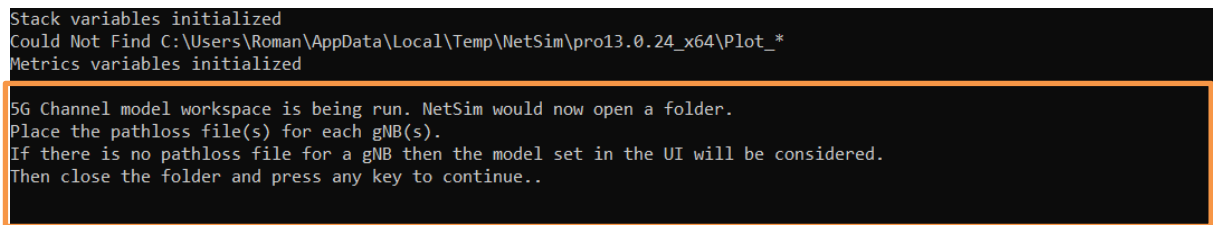


```
GNB_7_Pathloss - Notepad
File Edit Format View Help
xmax=1000,ymax=1000,zmax=100
xstep=5,ystep=5,zstep=10
-0, -0,0,137.759027464477
-0,5,0,137.69531485397
-0,10,0,137.632857177762
-0,15,0,137.571685063543
-0,20,0,137.511829025576
-0,25,0,137.45331942446
-0,30,0,137.396186425763
```

Note that if UE is placed at or moves to a location beyond xmax, ymax then the pathloss will be taken as 500 dB.

If input file is provided for a eNB/gNB then pathloss calculations will happen as per that, else NetSim will use the standard pathloss models to calculate the pathloss.

Once the simulation starts, the cmd window would look as shown below



```
Stack variables initialized
Could Not Find C:\Users\Roman\AppData\Local\Temp\NetSim\pro13.0.24_x64\Plot_*.Metrics variables initialized
5G Channel model workspace is being run. NetSim would now open a folder.
Place the pathloss file(s) for each gNB(s).
If there is no pathloss file for a gNB then the model set in the UI will be considered.
Then close the folder and press any key to continue..
```

Next, close the folder and press any key.

Simulation starts running.

Upon completion of simulation the impact of the pathloss input provided can be understood from the performance metrics parameters such as the application throughput, that are part of the results dashboard

Simulation Results

- Network Performance
 - Link_Metrics
 - Queue_Metrics
 - TCP_Metrics
 - IP_Metrics
 - > IP_Forwarding_Table
 - UDP Metrics
 - > Switch Mac address table
 - Application_Metrics
 - ITFNRCNDAP

Export Results (.xls/.csv)
 Print Results (.html)
 Open Packet Trace
 Open Event Trace
 > Log Files
 Restore To Original View

Application_Metrics_Table Detailed View

Application Id	Application Name	Packet generated	Packet received	Throughput (Mbps)	Del
1	App1_CBR	45000	5736	7.444053	276

TCP_Metrics_Table Detailed View

Source	Destination	Segment Sent	Segment Received	Ack Sent	Ack Received
LTE_EPC_1	ANY_DEVICE	0	0	0	0
UE_4	ANY_DEVICE	0	0	0	0
ROUTER_5	ANY_DEVICE	0	0	0	0
WIRED_NODE_6	ANY_DEVICE	0	0	0	0
UE_8	ANY_DEVICE	0	0	0	0
UE_9	ANY_DEVICE	0	0	0	0
UE_10	ANY_DEVICE	0	0	0	0
UE_11	ANY_DEVICE	0	0	0	0
UE_12	ANY_DEVICE	0	0	0	0
UE_13	ANY_DEVICE	0	0	0	0

Link_Metrics_Table Detailed View

Link_id	Link_throughput_plot	Packet_transmitted		Packet_errored		Packet_collided	
		Data	Control	Data	Control	Data	Control
All	NA	349204	34	277	0	0	0
1	NA	0	0	0	0	0	0
2	NA	36722	16	0	0	0	0
3	NA	73619	2	80	0	0	0
4	NA	73722	0	102	0	0	0
5	NA	11608	0	0	0	0	0
6	NA	73538	0	95	0	0	0
7	NA	36723	16	0	0	0	0
8	NA	43272	0	0	0	0	0

Queue_Metrics_Table Detailed View

Device_id	Port_id	Queued_packet	Dequeued_packet	Dropped_packet
1	2	1	1	0
5	1	73621	73621	0