# MATLAB INTERFACE FOR RPL DODAG VISUALIZATION

Software Recommended: NetSim Standard v11.1 (32bit/ 64bit), Visual Studio 2017/2019, MATLAB (32bit/ 64bit)

Note: This project works only MATLAB v2015b and onwards.

Follow the instructions specified in the following link to clone/download the project folder from GitHub using Visual Studio:

https://tetcos.freshdesk.com/support/solutions/articles/14000099351-how-to-clone-netsim-fileexchange-project-repositories-from-github-

Other tools such as GitHub Desktop, SVN Client, Sourcetree, Git from the command line, or any client you like to clone the Git repository.

**Note**: It is recommended not to download the project as an archive (compressed zip) to avoid incompatibility while importing workspaces into NetSim.

#### Secure URL for the GitHub repository:

### https://github.com/NetSim-TETCOS/RPL\_DODAG\_Formation\_Visualization\_in\_IOT\_Networks\_v11.1.git

#### Steps to run MATLAB interface

1. After downloading the project folder using the GitHub URL, Open NetSim Home Page click on **Open Simulation** option,

NetSim Home			
NetSim Standard Network Simulation/Emulation Plat Version 11.1.11 (32 Bit)	<b>d</b> Itorm		www.tetcos.com
New Simulation Ctrl+N	Choose a Network		
	Internetworks	Wireless Sensor Networks	
Open Simulation Ctrl+O	Legacy Networks	Internet Of Things	
Examples	Pure Aloha	Cognitive Radio Networks	
	Slotted Aloha	Long-Term Evolution Networks	
	Cellular Networks	LTE/LTE-A Networks	
	GSM	LTE FemtoCell	
	CDMA	LTE D2D	
	Mobile Adhoc Networks	LTE Vanet	
License Settings	Single MANET	VANET	
	Multiple MANETs		
Support	Learn	Documentation	Contact us
Answers/FAQ Contact Technical Support Email - support@tetcos.com	Videos Experiments Manual	User Manual Technology Libraries Source Code Help	Email - sales@tetcos.com Phone - +91 767 605 4321

2. Click on Workspace options

NetSim Home						
NetSim Sta Network Simulation/Er Version 11.1.11 (32 Bit)	andard	orm				New States
		Current workspace: WorkSpace_DO	DDAG_Visualization		C Experiment name	
New Simulation	Ctrl+N	Experiment name	Date modified	Network type		
Open Simulation	Ctrl+O	DODAG_Visualization_Example	26-03-2019	Internet_of_Things	View Results	Export 🔟
Examples						
License Settings						
		Workspace options			h	mport Experiment
Support		Learn		Documentation	Contact us	
Answers/FAQ Contact Technical Supp Email - support@tetco	port s.com	Videos Experiments Manual		User Manual Technology Libraries Source Code Help	Email - sale Phone - +9	s@tetcos.com 1 767 605 4321

## 3. Click on More Options,

NetSim Home					- 0
NetSim Standard Network Simulation/Emulation Plat Version 11.1.11 (32 Bit)	d				www.tetcos.co
	Current workspace: WorkSpace_DO	DAG_Visualization		C Experiment name	
New Simulation Ctrl+N	Experiment name	Date modified	Network type		
Open Simulation Ctrl+O	DODAG_Visualization_Example	26-03-2019	Internet_of_Things	View Results	Export 🕅
Examples					
License Settings					
	Onen code Reset G	Reset Rina	ries More onti	205	Back
Support	Learn		Documentation	Contact	
Answers/FAQ Contact Technical Support Email - support@tetcos.com	Videos Experiments Manual		User Manual Technology Libraries Source Code Help	Email - sa Phone - ·	ales@tetcos.com +91 767 605 4321

**4.** Click on **Import**, browse the extracted folder path and go into the Workspace\_DODAG\_Visualization directory. Click on the Select folder button and then on **OK**.

NetSim Home NetSim Standa Network Simulation/Emulation 1 Version 1111 (32 8th)	rd latform			×
	Current workspace: WorkSpace_DODAG_Visual	ization		www.tetcos.com
New Simulation Ctrl+N	WorkSpace Archine the explanation of the	A second in the first section and insect	Event	1
Open Simulation Ctrl+O	them. Browse the respective Works	pace folder and import it as a current	Export	
	WorkSpace, working Workspace. This will impo	rt all the folders experiments.	Export	<u> </u>
Examples	WorkSpace Import from F:\v11.1_Proje	ects\RPL_DODAG_Formatic	Export	 ⊡
	WorkSpace		Export	Ē
	WorkSpace		Export	Ē
	WorkSpace_dynamic_clustering F:\v11.1_Project\	Export	Ē	
	WorkSpace_IDS_in_LEACH F:\v11.1_Project\	IDS_in_LEACH_v11.1	Export	Ē
	WorkSpace_Rebroadcasting F:\v11.1_Project\	Rebroadcasting_in	Export	Ē
License Settings	WorkSpace_SinkHole_Attack F:\v11.1_Project\	SinkHole_Attack_in	Export	1
	New Import	Set as Current		Back
Support	Learn	Documentation	Contact us	
Answers/FAQ Contact Technical Support Email - support@tetcos.com	Videos Experiments Manual	User Manual Technology Libraries Source Code Help	Email - sales@te Phone - +91 767	cos.com 605 4321

5. Go to home page, Click on Open Simulation  $\rightarrow$  Workspace options  $\rightarrow$  Open code

NetSim Home						- 0
NetSim St Network Simulation/En Version 11.1.11 (32 Bit	andard mulation Platf	orm				WWW.tetcos.co
		Current workspace: WorkSpace_DOL	DAG_Visualization		C Experiment name	
New Simulation	Ctrl+N	Experiment name	Date modified	Network type		
Open Simulation	Ctrl+O	DODAG_Visualization_Example	26-03-2019	Internet_of_Things	View Results	Export 🕅
Examples						
Support		Open code Reset Co	ode Reset Bina	More opti	ions	Back
Answers/FAQ Contact Technical Sup Email - support@tetcc	port vs.com	Learn Videos Experiments Manual		User Manual Technology Libraries Source Code Help	Email - sa Phone	us ales@tetcos.com +91 767 605 4321

6. Place PlotDAG.m file inside the MATLAB root directory. For Eg: "<MATLAB installed path>\MATLAB\R2015b", (Note: PlotDAG.m is provided inside the MATLAB\_Code directory)

- 7. Following modifications were done to the RPL project for this implementation:
  - a. Open RPL.c file and add fn\_netsim\_matlab\_init(), fn\_netsim\_matlab\_DODDAG\_run() and fn\_netsim\_matlab\_DODDAG\_Init() inside fn\_NetSim\_RPL\_Init() and fn\_netsim\_matlab\_Finish() inside fn\_NetSim\_WLAN\_Finish ().

Neighbor c	MATLAB Interface c	RPL c - P X	
the ppi	MATERO_Interface.c	(Global Scope)	- 🤗 fn NetSim PDL Init(ctru NetSim Networ -
	- /**	(Giobal Scope)	
25		-litere the ppr	Ŧ
26	RPL INIT TUNCTION INITIA	alizes the RPL para	ameters.
27		t fa Nation DDL T	it/struct stru NotCin Natural &NETHORY Formal
20	_decispec (dilexport) in	NC IN_NECSIM_RPL_I	NetSim EVENTDETATIS *nstruEventDetails Formal
30			chap *nczAppPath Formal
31			char *nszWritePath Formal.
32			int nVersion Type.
33			void **fnPointer)
34	<u>ًا (</u>		
35	fn netsim matlab in:	it();	
36	fn netsim matlab DO	DDAG Init();	
37	fn_netsim_matlab_DO	DDAG_run();	
38	_getch();		
39	return fn_NetSim_RP	L_Init_F();	_
40	}		
41			
42			
46	<u>■_declspec</u> (dllexport) in	nt fn_NetSim_RPL_R	un() { }
104			
105			110
109	□_declspec(dllexport) in	t fn_NetSim_RPL_Fi	nish()
110	i		_
111	_getch(); fo potsim motlob fi	nich().	
112	TH_HECSIM_MACIAD_TH	HISH();	
114	3	())	
115	L J		*
99 % 🔹 🖣			

- b. Add definitions of the following functions inside RPL.h file
  - a. double fn\_netsim\_matlab\_init();
  - b. double fn\_netsim\_matlab\_DODDAG\_Init();
  - c. double fn\_netsim\_matlab\_DODDAG\_run();
- c. double fn\_netsim\_matlab\_finish();

RPL.c 🕈	Neighbor.c	RPL_Message	.h ≅	RPL.h ⇒ ×			-
\Lambda RPL		-	(Global So	cope)		<ul> <li>         fn_netsim_matlab_finish()     </li> </ul>	-
21	#define N	IFTSTM RPL H					÷
22	E#ifdef	colusolus					<b></b>
23	extern "C"	{					
24	#endif	L.					
25							
26	//Log	settings					
27	#define DE	BUG_RPL					
28	⊨#ifdef DEB	UG_RPL					
29	//#define	DEBUG_RPL_PRI	VT_IP_TABLE	E			
30	#define DE	BUG_RPL_PRINT	DAO_ROUTE	INFOMATIO	N		
31	//#define	DEBUG_RPL_TRI	CKLE				
32	#endif						
33							
34							
35	#include "	'RPL_Message.h'					
36							
37	//Incl	ude necessary	lib's				
38	#pragma co	mment(lib,"Net	tworkStack	.lib")			
39	#pragma_co	mment(lib "RP	lib.lib")	\ \			
40	double	fn_netsim_mat	tlab_init()	);			
41	double	fn_netsim_mat	tlab_DODDAG	<pre>5_Init();</pre>			
42	double	fn_netsim_ma	tlab_DODDAG	a_run();			
45	double	in_necsim_ma	ciab_rinis	() i			
44	/*						
46	/ * Mavi	mum amount of	timer doub	hling			
40	*	and another of	camer dout				-
99 % • 4							•

d. Go to the Neighbor.c file. Inside Function void choose\_parents\_and\_siblings(NETSIM\_ID
d) add fn\_netsim\_matlab\_DODDAG\_run() below rpl\_add\_route\_to\_parent()



**8.** Create a user variable with the name of MATLAB\_PATH and provide the path of the installation directory of user's respective MATLAB version.

Edit User Variable	X
Variable <u>n</u> ame:	MATLAB_PATH
Variable <u>v</u> alue:	C:\Program Files (X86)\MATLAB\R2015b
	OK Cancel

9. Make sure that the following directory is in the PATH(Environment variable) <Path where MATLAB is installed>\bin\win32

Edit environment variable	×
C:\Program Files\MATLAB\R2015b\bin\win32	New
%C_EM64T_REDIST11%bin\Intel64	Edit
C:\WINDOWS\system32	
C:\WINDOWS	Browse
C:\WINDOWS\System32\Wbem	
%SystemRoot%\system32	Delete
%SystemRoot%	
%SystemRoot%\System32\Wbem	
%SYSTEMROOT%\System32\WindowsPowerShell\v1.0\	Move Up
C:\Program Files\Microsoft SQL Server\120\Tools\Binn\	
C:\Program Files (x86)\Windows Kits\10\Windows Performance Toolkit\	Move Down
C:\Program Files\MATLAB\R2016a\runtime\win64	
C:\Program Files\MATLAB\R2016a\polyspace\bin	
C:\Program Files\MATLAB\R2016a\bin\win64	Edit text
ОК	Cancel

(**Note:** To run this code 32- bit version of MATLAB must be installed in your system. If you are interfacing for the first time then open command window and go to the **<NetSim installed directory>\bin** and type **matlab -regserver**)



- 10. Now Right Click on RPL project and select Rebuild.
- **11.** Upon rebuilding, **RPL.dll** will automatically be updated in the respective bin folder of the current workspace.

### Note:

• Based on whether you are using NetSim 32 bit or 64 bit setup you can configure Visual studio to build 32 bit or 64 bit Dll files respectively as shown below:



• While importing the workspace, if the following warning message indicating Software Version Mismatch is displayed, you can ignore it and proceed.



Go to NetSim home page, click on Open Simulation, Click on DODAG\_Visualization\_Example.



Set Velocity to the sensors

N lot_Sensors		- 0	×				
lot_Sensors	▼ GENERAL						
	Device Name	Sensor D					
GENERAL	Туре	SENSOR					
APPLICATION_LAYER	Device Type	IOT_Sensors					
TRANSPORT_LAYER	X / Lat	169.93					
NETWORK LAYER	Y / Lon	201.02					
	Z	0					
INTERFACE_T (ZIGBEE)	WireShark Capture	Disable 👻					
	Interface Count	1					
	Mobility_Model	RANDOM_WAY_POINT -					
	Velocity(m/s)	30					
	Calculation_Interval(s)	1.0					
	PauseTime(s)	1					
	ОК	Reset					

### **Output:**

A plot will open, showing the DODAG when the simulation is started and the first route is formed between sink node and the sensor. And the DODAG will be dynamically updated.

### Initially formed DODAG





DODAG formed after some time due to movement in sensors

After simulation press any key in the NetSim command window to close the MATLAB.