

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-file-exchange-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.

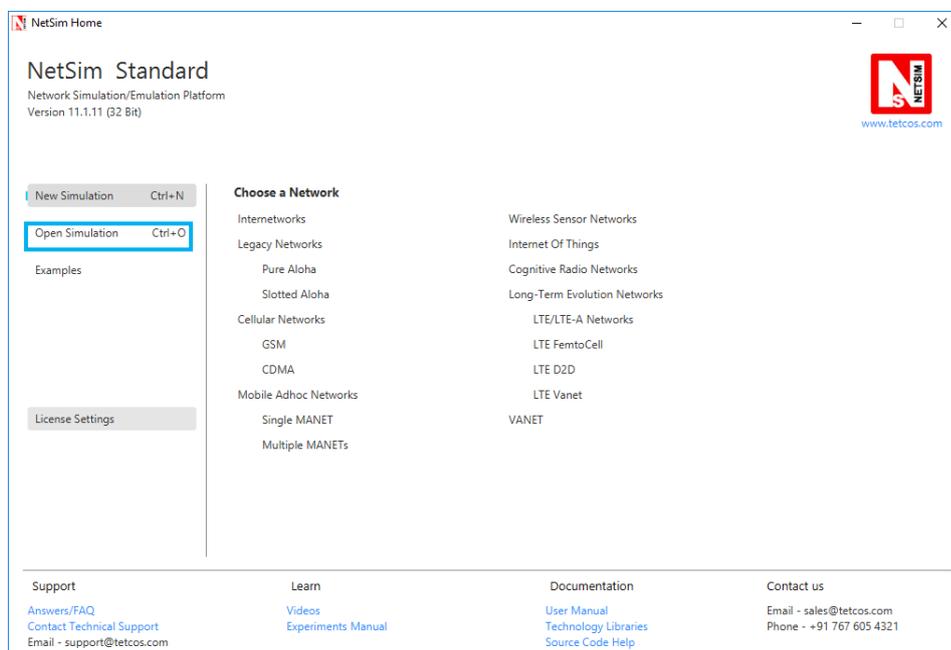
Secure URL for the GitHub repository:

<https://github.com/NetSim->

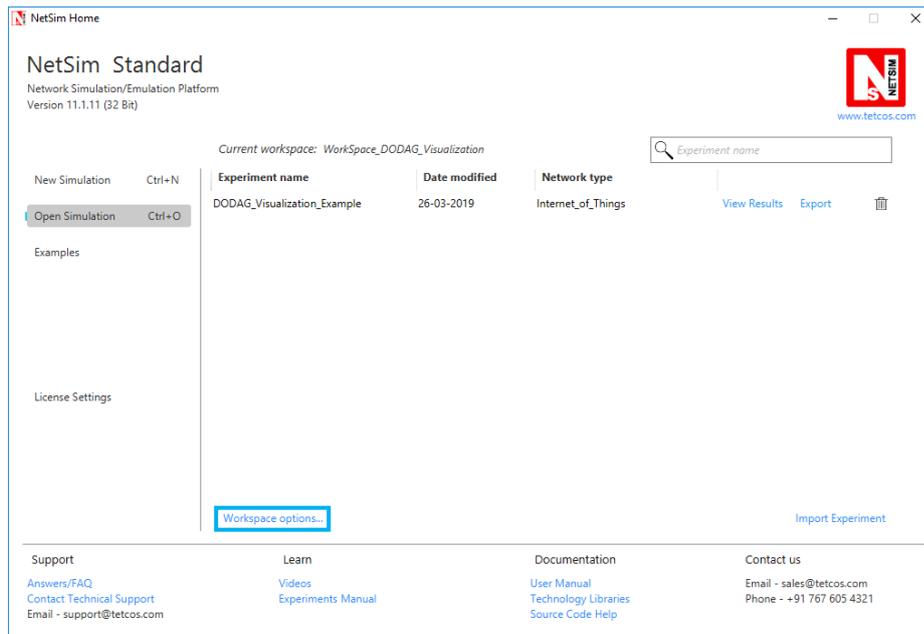
[TETCOS/RPL_DODAG_Formation_Visualization_in_IOT_Networks_v11.1.git](https://github.com/NetSim-TETCOS/RPL_DODAG_Formation_Visualization_in_IOT_Networks_v11.1.git)

Steps to run MATLAB interface

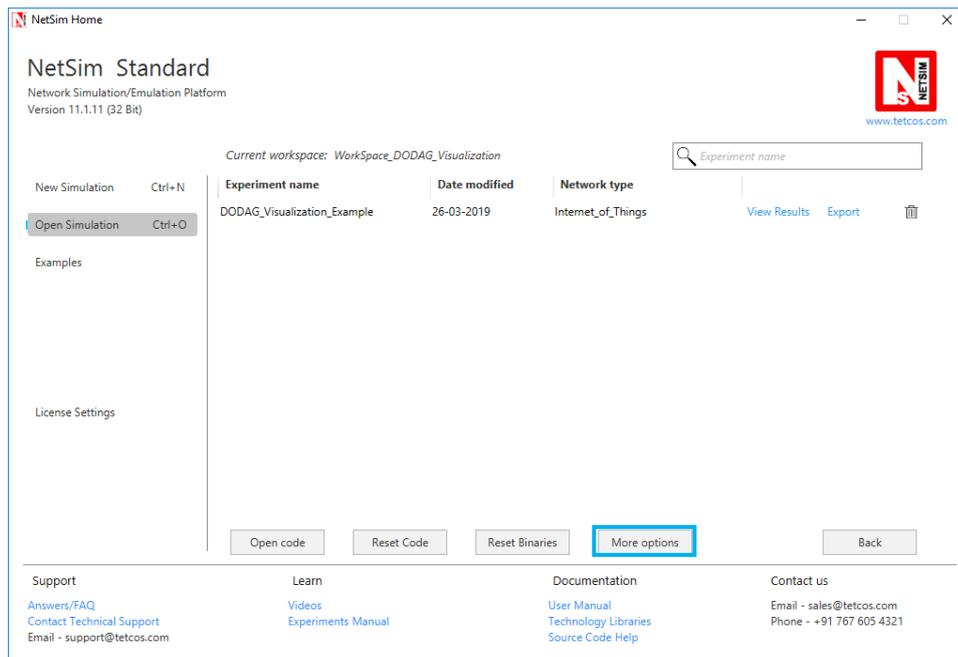
1. After downloading the project folder using the GitHub URL, Open NetSim Home Page click on **Open Simulation** option,



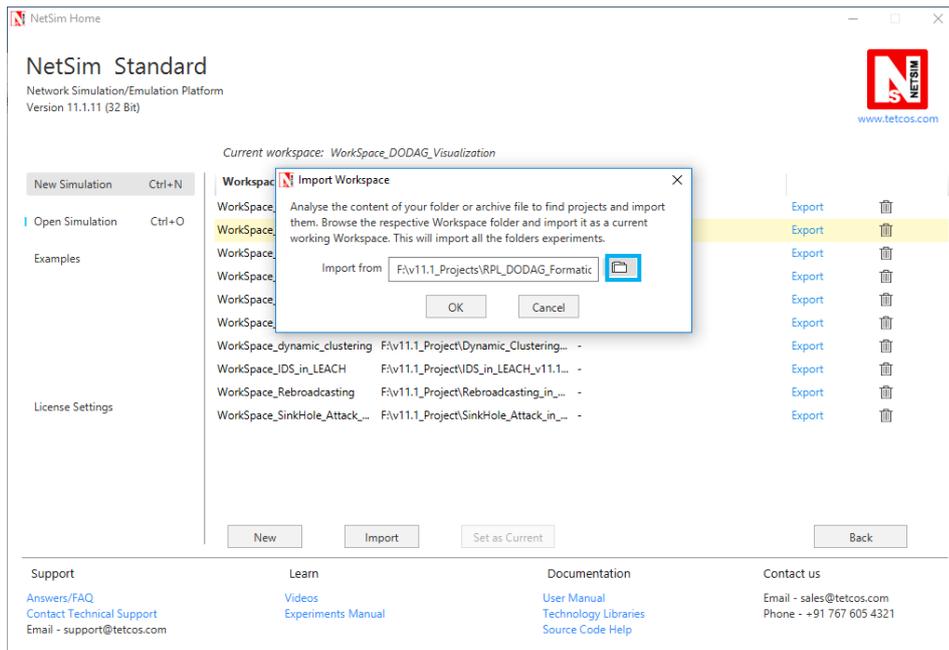
2. Click on **Workspace options**



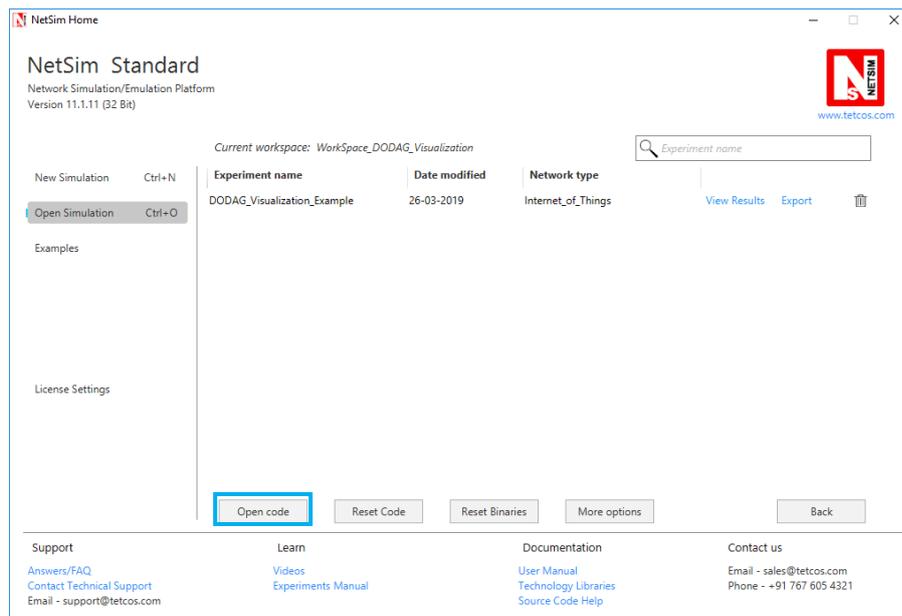
3. Click on **More Options**,



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**.



5. Go to home page, Click on **Open Simulation** → **Workspace options** → **Open code**



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()`.

```

25  /**
26  RPL Init function initializes the RPL parameters.
27  */
28  _declspec(dllexport) int fn_NetSim_RPL_Init(struct stru_NetSim_Network *NETWORK_Formal,
29                                             Netsim_EVENTDETAILS *pstruEventDetails_Formal,
30                                             char *pszAppPath_Formal,
31                                             char *pszWritePath_Formal,
32                                             int nVersion_Type,
33                                             void **fnPointer)
34  {
35      fn_netsim_matlab_init();
36      fn_netsim_matlab_DODDAG_Init();
37      fn_netsim_matlab_DODDAG_run();
38      _getch();
39      return fn_NetSim_RPL_Init_F();
40  }
41
42  /** ... */
46  _declspec(dllexport) int fn_NetSim_RPL_Run({ ... })
47
104
105  /** ... */
109  _declspec(dllexport) int fn_NetSim_RPL_Finish()
110  {
111      _getch();
112      fn_netsim_matlab_finish();
113      return fn_NetSim_RPL_Finish_F();
114  }
115
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();`

```

21  #ifndef _NETSIM_RPL_H_
22  #define _NETSIM_RPL_H_
23  #ifdef __cplusplus
24  extern "C" {
25  #endif
26
27      //Log settings
28      #define DEBUG_RPL
29      // #define DEBUG_RPL_PRINT_IP_TABLE
30      #define DEBUG_RPL_PRINT_DAO_ROUTE_INFOMATION
31      // #define DEBUG_RPL_TRICKLE
32  #endif
33
34
35  #include "RPL_Message.h"
36
37  //Include necessary lib's
38  #pragma comment(lib,"NetworkStack.lib")
39  #pragma comment(lib,"RPLlib.lib")
40
41  double fn_netsim_matlab_init();
42  double fn_netsim_matlab_DODDAG_Init();
43  double fn_netsim_matlab_DODDAG_run();
44  double fn_netsim_matlab_finish();
45
46  /*
47  * Maximum amount of timer doubling.
  
```

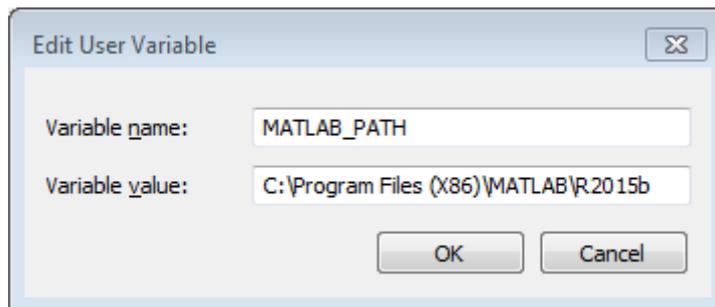
- d. Go to the **Neighbor.c** file. Inside Function `void choose_parents_and_siblings(NETSIM_ID d)` add `fn_netsim_matlab_DODDAG_run()` below `rpl_add_route_to_parent()`

```

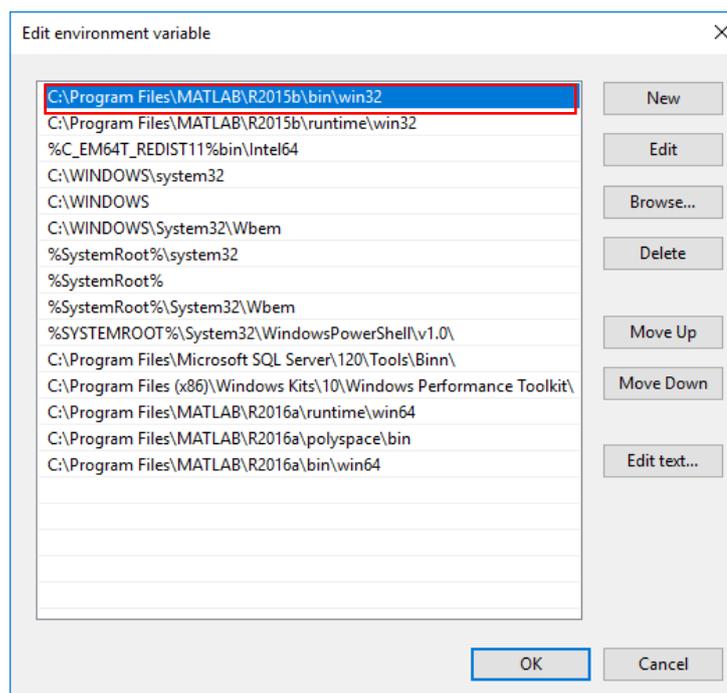
RPL.c # Neighbor.c # RPL_Message.h # RPL.h
(Global Scope) choose_parents_and_siblings(NETSIM_ID)
306 dodag->pref_parent = rpl->neighbor_list[best_rank_index];
307 if (dodag->pref_parent->nodeId != old_pref_parent)
308 {
309     NetSim_EVENTDETAILS pevent;
310     memset(&pevent, 0, sizeof pevent);
311     pevent.dEventTime = pstruEventDetails->dEventTime;
312     pevent.nDeviceId = d;
313     pevent.nDeviceType = DEVICE_TYPE(d);
314     pevent.nEventType = TIMER_EVENT;
315     pevent.nProtocolId = Nj_PROTOCOL_RPL;
316     pevent.nSubEventType = RPL_NEW_PREF_PARENT;
317     fnpAddEvent(&pevent);
318 }
319 rpl_add_route_to_parent(d, dodag->pref_parent->nodeId);
320 fn_netsim_matlab_DODDAG_run();
321
322 for (i = 0; i < rpl->neighbor_count; i++)
323 {
324     PRPL_NEIGHBOR neighbor = rpl->neighbor_list[i];
325     if (matching_ranks[i] >= INFINITE_RANK)
326     {
327         if (neighbor->lastDIOMSG != NULL)
328         { /* forget messages from other DODAG iterations */
329             rpl_dio_pdu_free(neighbor->lastDIOMSG);
330             neighbor->lastDIOMSG = NULL;
331         }
332     }
333 }

```

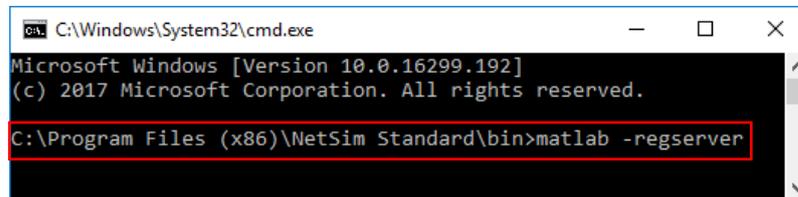
8. Create a user variable with the name of MATLAB_PATH and provide the path of the installation directory of user's respective MATLAB version.



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



(**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**)

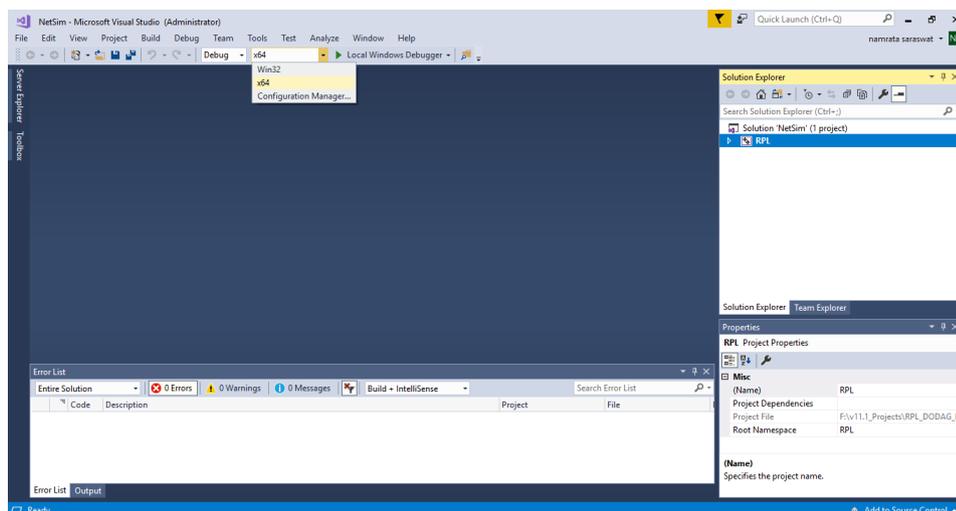


```
C:\Windows\System32\cmd.exe
Microsoft Windows [Version 10.0.16299.192]
(c) 2017 Microsoft Corporation. All rights reserved.
C:\Program Files (x86)\NetSim Standard\bin>matlab -regserver
```

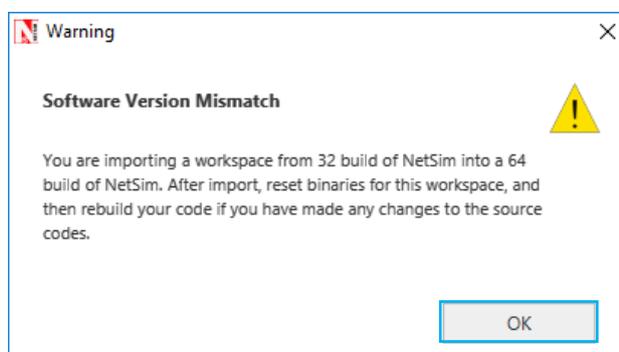
10. Now Right Click on RPL project and select Rebuild.
11. Upon rebuilding, **RPL.dll** will automatically be updated in the respective bin folder of the current workspace.

Note:

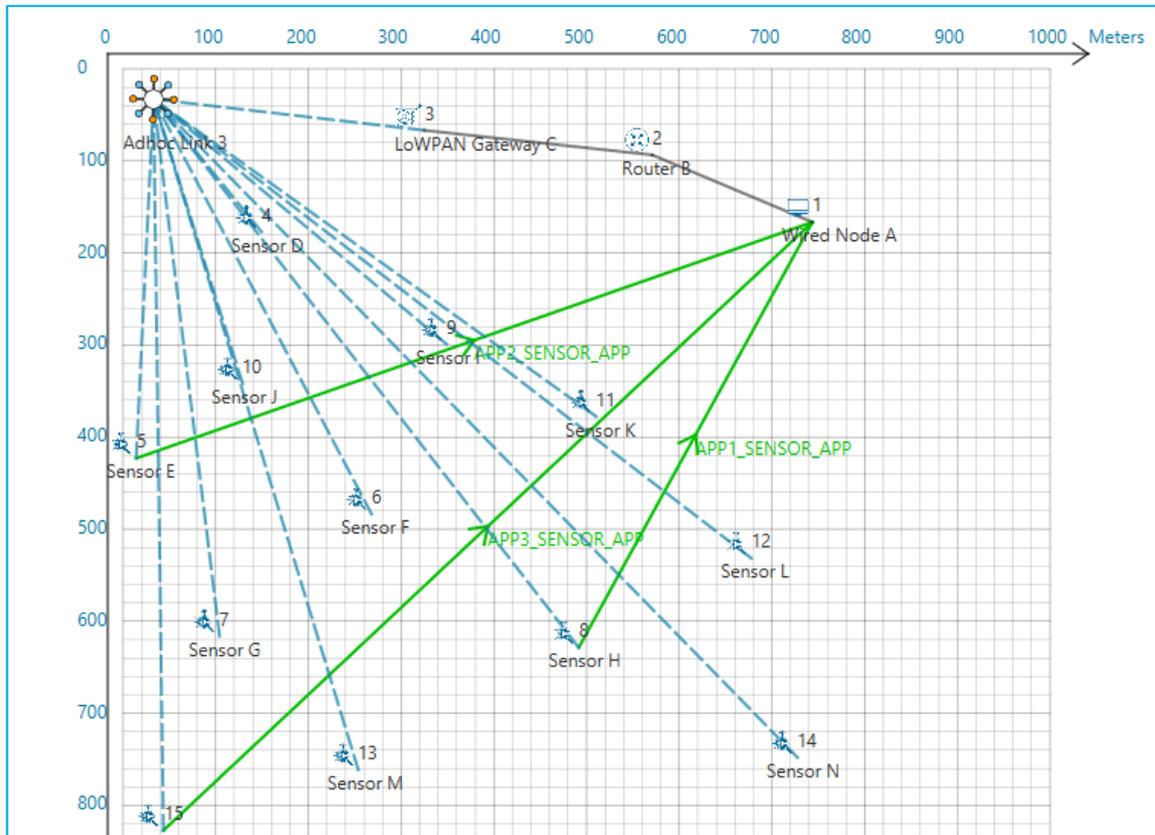
- Based on whether you are using NetSim 32 bit or 64 bit setup you can configure Visual studio to build 32 bit or 64 bit Dll files respectively as shown below:



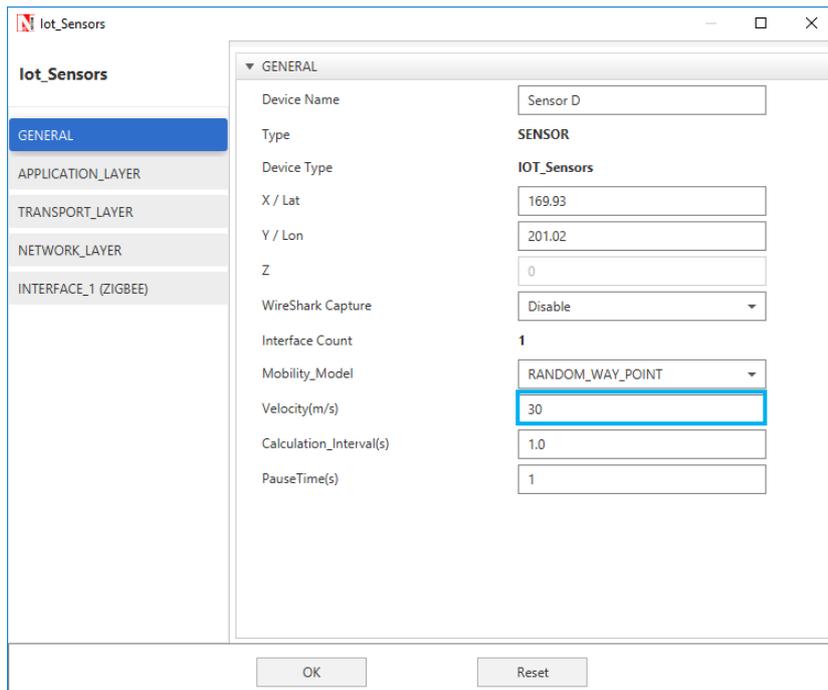
- While importing the workspace, if the following warning message indicating Software Version Mismatch is displayed, you can ignore it and proceed.



- Go to NetSim home page, click on **Open Simulation**, Click on **DODAG_Visualization_Example**.



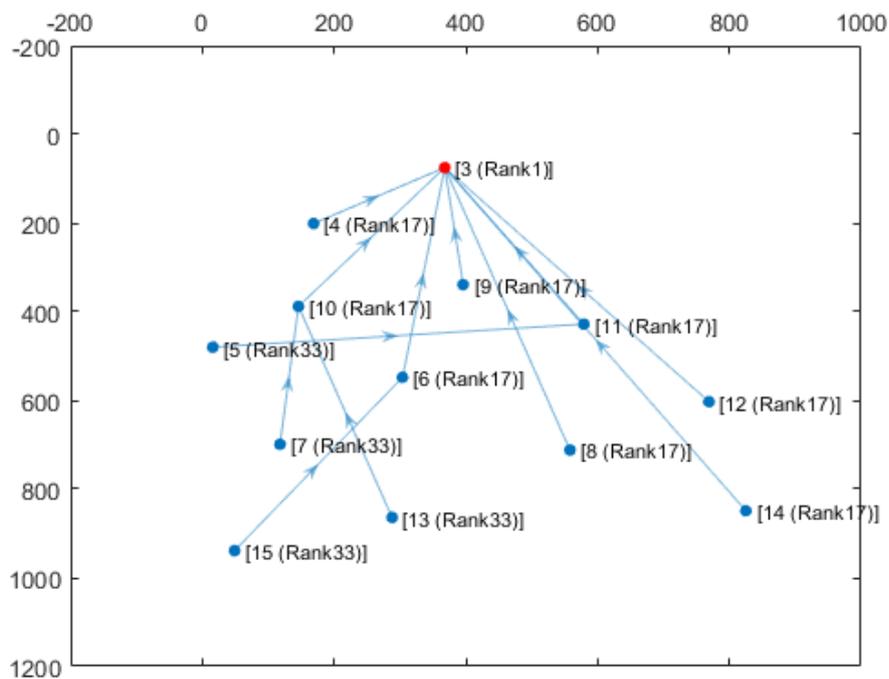
Set Velocity to the sensors



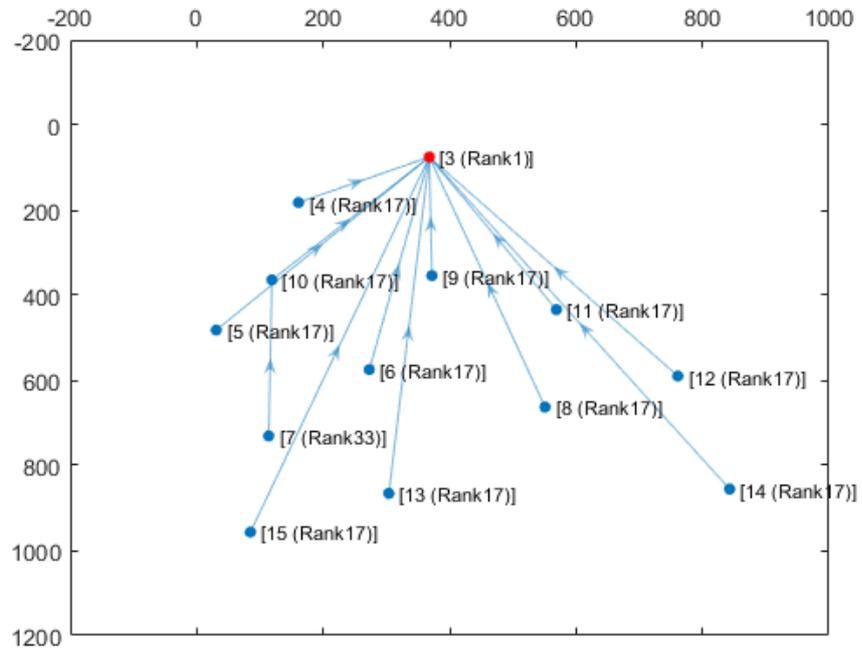
Output:

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.