# Sink Hole Attack using RPL in IOT

**Software Recommended:** NetSim Standard v12.1 (32-bit/ 64-bit), Visual Studio 2017/2019

In sinkhole Attack, a compromised node or malicious node advertises fake rank information to form the fake routes. After receiving the message packet, it drop the packet information. Sinkhole attacks affect the performance of IoT networks protocols such as RPL protocol.

## Implementation in RPL (for 1 sink)

- In RPL the transmitter broadcasts the DIO during DODAG formation.
- The receiver on receiving the DIO from the transmitter updates its parent list, sibling list, rank and sends a DAO message with route information.
- Malicious node upon receiving the DIO message it does not update the rank instead it always advertises a fake rank.
- The other node on listening to the malicious node DIO message the update their rank according to the fake rank.
- After the formation of DODAG, if the node that is transmitting the packet has malicious node as the preferred parent, transmits the packet to it but the malicious node instead of transmitting the packet to its parent, it simply drops the packet resulting in zero throughput.

A file Malicious.c is added to the RPL project.
The file contains the following functions

1. **fn_NetSim_RPL_MaliciousNode( )**
   This function is used to identify whether a current device is malicious or not in-order to establish malicious behaviour.
2. **fn_NetSim_RPL_MaliciousRank( )**
   This function is used to give a fake rank to the malicious node.
3. **rpl_drop_msg( )**
   This function is used to drop the packet by the malicious node if it enters into its network layer.

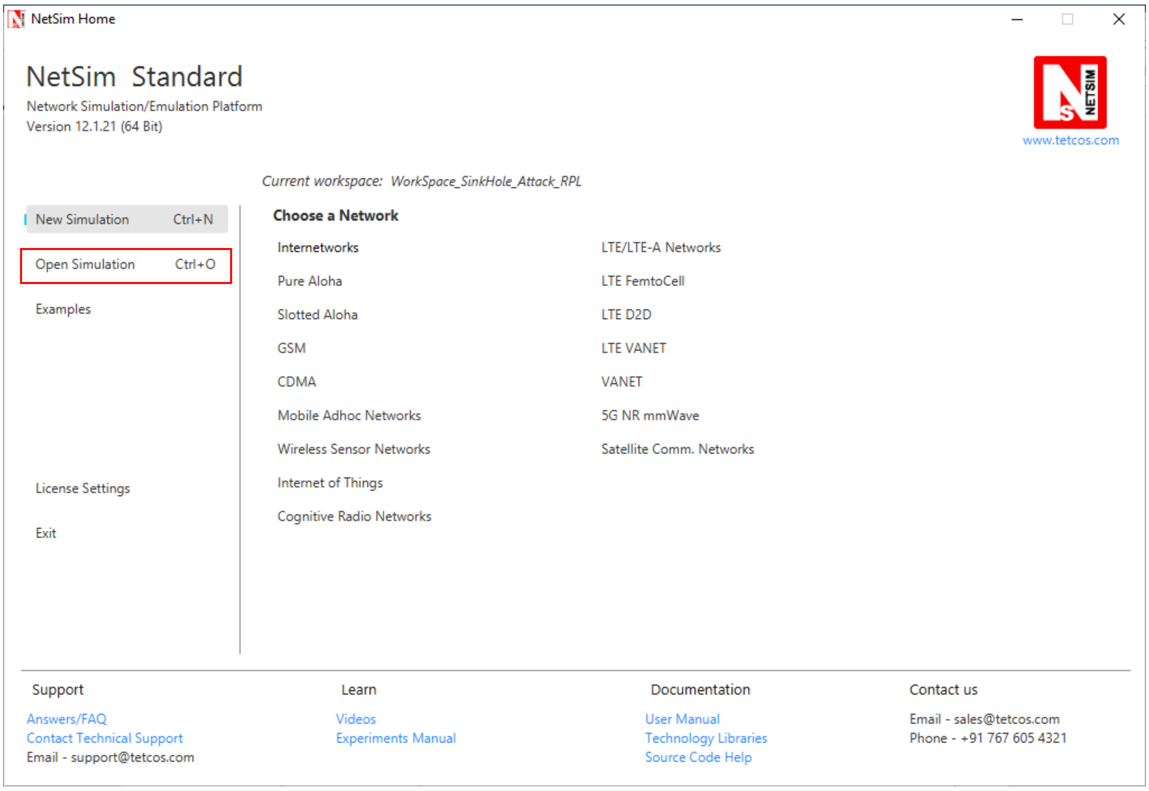
**Sink Hole attack** – The malicious node advertises the fake rank.
**fn_NetSim_RPL_MaliciousRank( )** is the sink hole attack function.

**Black Hole attack** – The malicious node drops the packet.
**rpl_drp_msg()** is the black hole attack function

You can set any device as malicious and you can have more than one malicious node in a scenario. Device id's of malicious nodes can be set inside the fn_NetSim_RPL_MaliciousNode() function.

### Steps:

1. After you unzip the downloaded project folder, Open NetSim Home Page click on **Open Simulation** option,



NetSim Home

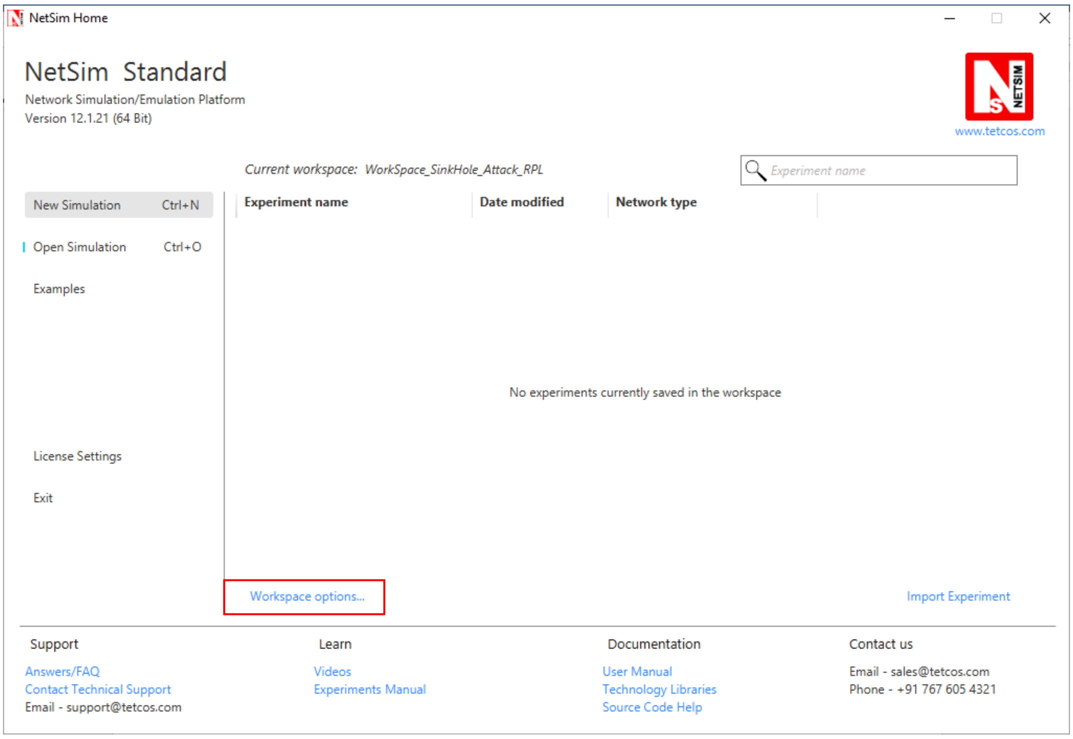
NetSim Standard

Network Simulation/Emulation Platform

Version 12.1.21 (64 Bit)

Current workspace: WorkSpace_SinkHole_Attack_RPL

2. Click on **Workspace options**



NetSim Home

NetSim Standard

Network Simulation/Emulation Platform

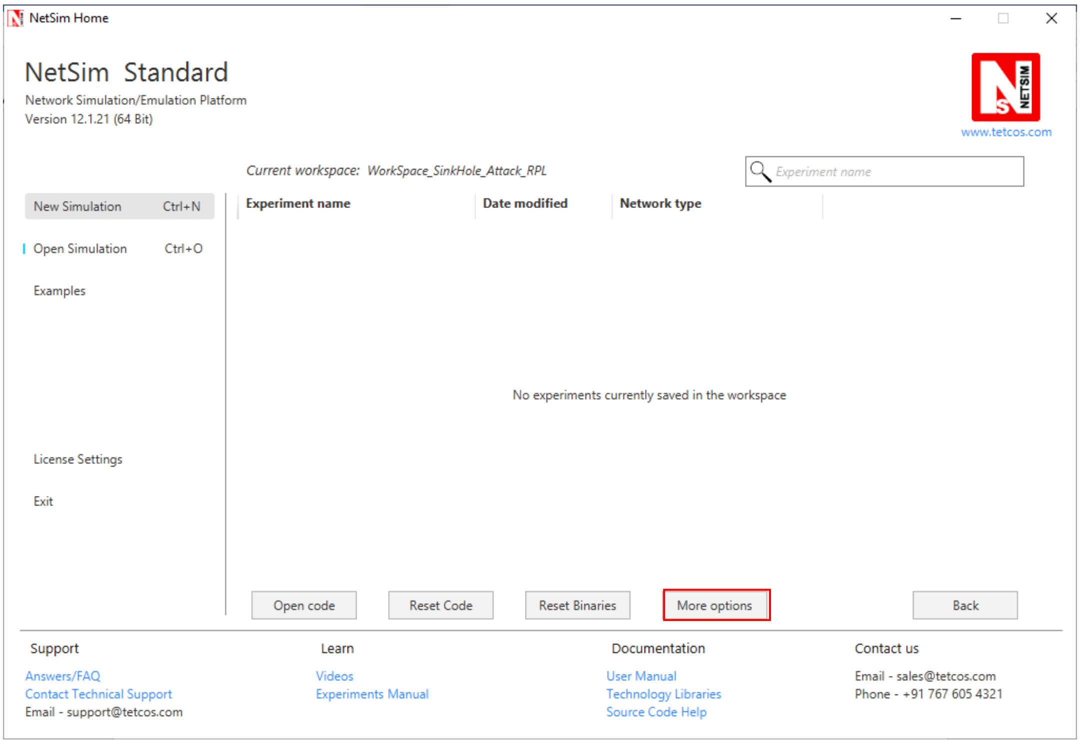
Version 12.1.21 (64 Bit)

Current workspace: WorkSpace_SinkHole_Attack_RPL

| Experiment name | Date modified | Network type |
|---|---|---|

No experiments currently saved in the workspace

3. Click on **More Options,**



*Current workspace: WorkSpace_SinkHole_Attack_RPL*

No experiments currently saved in the workspace

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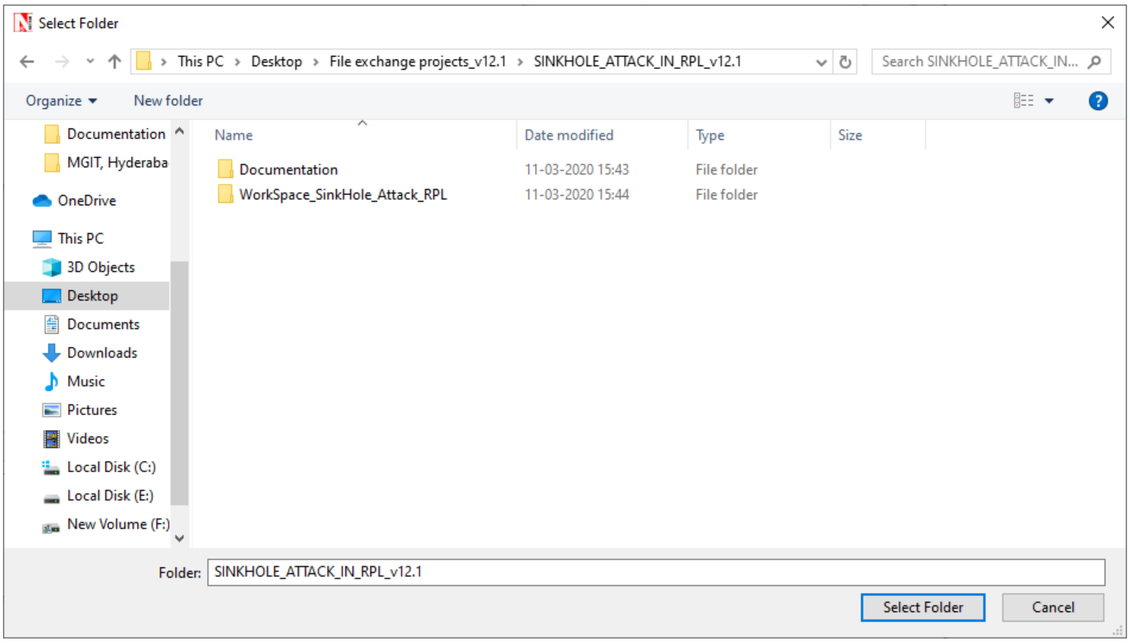
Phone - +91 767 605 4321

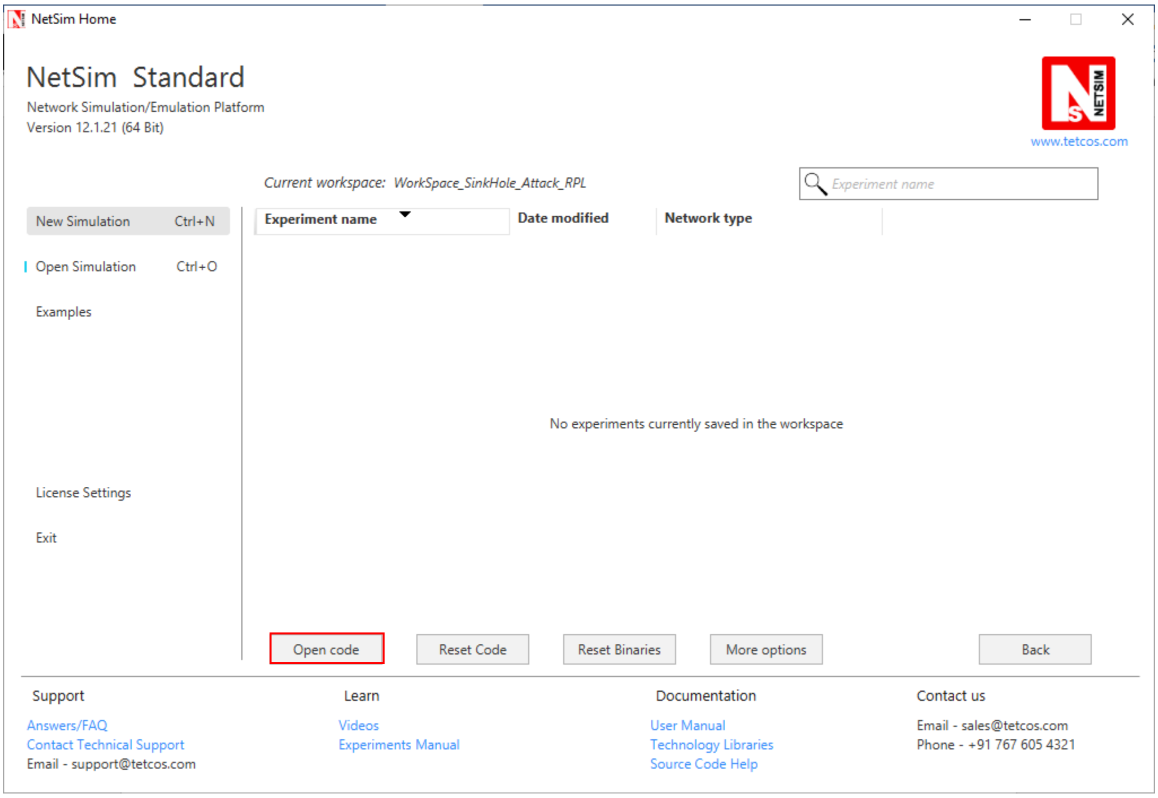
4. Click on **Import**, browse the extracted folder path and go into the WorkSpace_SinkHole_Attack_RPL directory. Click on Select folder button and then on **OK.**



| Name | Date modified | Type | Size |
|---|---|---|---|
| Documentation | 11-03-2020 15:43 | File folder | |
| WorkSpace_SinkHole_Attack_RPL | 11-03-2020 15:44 | File folder | |

Folder: SINKHOLE_ATTACK_IN_RPL_v12.1

5. Go to home page, Click on **Open Simulation** >**Workspace options** and click on the**Open code** button.



Current workspace: WorkSpace_SinkHole_Attack_RPL

No experiments currently saved in the workspace

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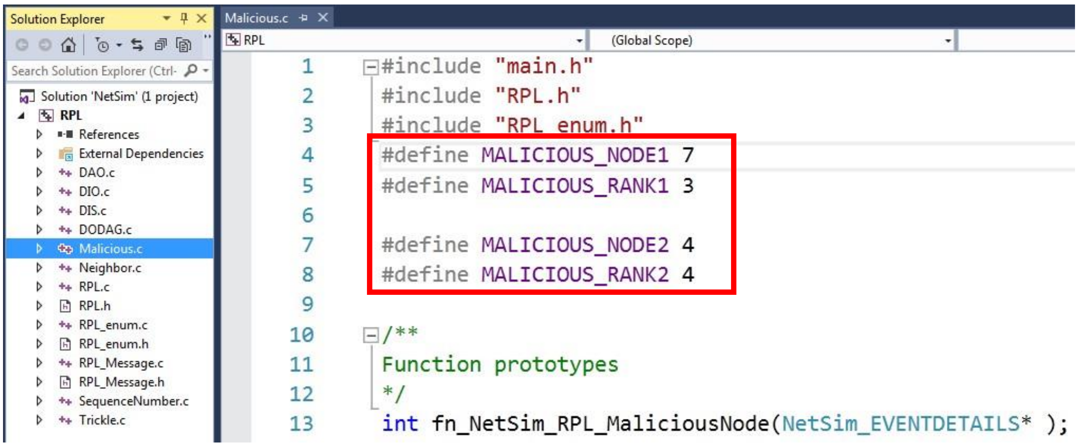
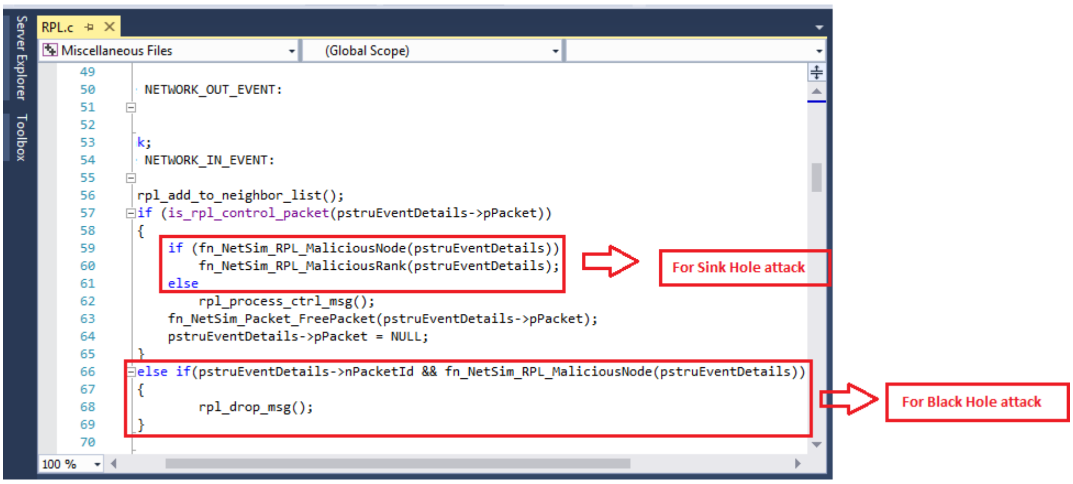
6. Set malicious node id and the fake Rank.



```
#include "main.h"
#include "RPL.h"
#include "RPL_enum.h"
#define MALICIOUS_NODE1 7
#define MALICIOUS_RANK1 3

#define MALICIOUS_NODE2 4
#define MALICIOUS_RANK2 4

/**
Function prototypes
*/
int fn_NetSim_RPL_MaliciousNode(NetSim_EVENTDETAILS* );
```

7. Add the code that is highlighted in RPL.c file

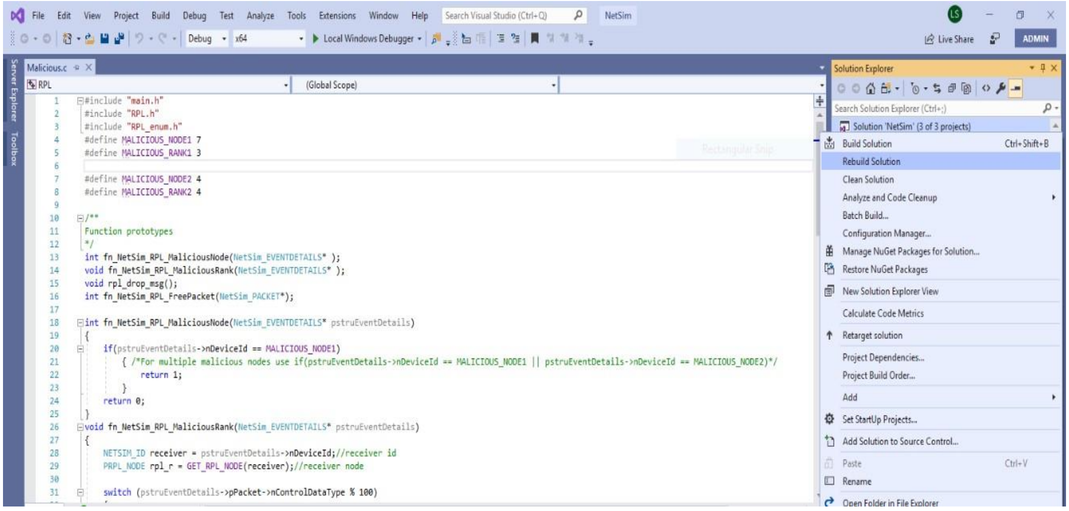


```

 NETWORK_OUT_EVENT:



k;
 NETWORK_IN_EVENT:

rpl_add_to_neighbor_list();
if (is_rpl_control_packet(pstruEventDetails->pPacket))
{
    if (fn_NetSim_RPL_MaliciousNode(pstruEventDetails))
        fn_NetSim_RPL_MaliciousRank(pstruEventDetails);
    else
        rpl_process_ctrl_msg();
    fn_NetSim_Packet_FreePacket(pstruEventDetails->pPacket);
    pstruEventDetails->pPacket = NULL;
}
else if(pstruEventDetails->nPacketId && fn_NetSim_RPL_MaliciousNode(pstruEventDetails))
{
        rpl_drop_msg();
}

```

For Sink Hole attack

For Black Hole attack

8. Now right click on Solution explorer and select Rebuild.

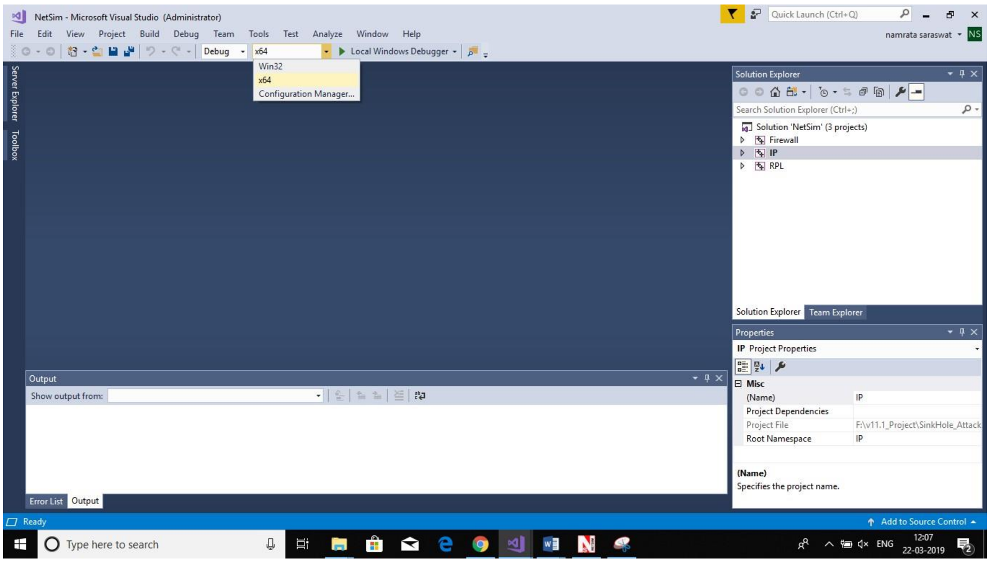


```c
#include "main.h"
#include "RPL.h"
#include "RPL_enum.h"
#define MALICIOUS_NODE1 7
#define MALICIOUS_RANK1 3

#define MALICIOUS_NODE2 4
#define MALICIOUS_RANK2 4

/**
Function prototypes
*/
int fn_NetSim_RPL_MaliciousNode(NetSim_EVENTDETAILS* );
void fn_NetSim_RPL_MaliciousRank(NetSim_EVENTDETAILS* );
void rpl_drop_msg();
int fn_NetSim_RPL_FreePacket(NetSim_PACKET*);

int fn_NetSim_RPL_MaliciousNode(NetSim_EVENTDETAILS* pstruEventDetails)
{
    if(pstruEventDetails->nDeviceId == MALICIOUS_NODE1)
        { /*For multiple malicious nodes use if(pstruEventDetails->nDeviceId == MALICIOUS_NODE1 || pstruEventDetails->nDeviceId == MALICIOUS_NODE2)*/
            return 1;
        }
    return 0;
}
void fn_NetSim_RPL_MaliciousRank(NetSim_EVENTDETAILS* pstruEventDetails)
{
    NETSIM_ID receiver = pstruEventDetails->nDeviceId;//receiver id
    PRPL_NODE rpl_r = GET_RPL_NODE(receiver);//receiver node

    switch (pstruEventDetails->pPacket->nControlDataType % 100)
```

9. Upon rebuilding, **libRPL.dll, libIP.dll,SupportFunction.dll** and **Firewall.dll** will automatically get replaced in the respective bin folders of the current workspace

**Note:**

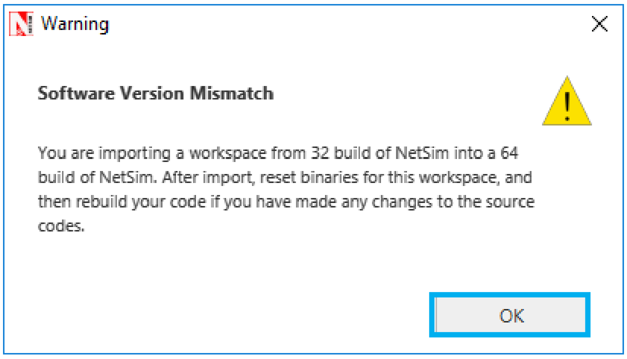
1. Based on whether you are using NetSim 32 bit or 64 bit setup you can configure Visual studio to build 32 bit or 64 bit Dll files respectively as shown below:



(Name) IP
Project Dependencies
Project File F:\v11.1_Project\SinkHole_Attack
Root Namespace IP

(Name)
Specifies the project name.

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

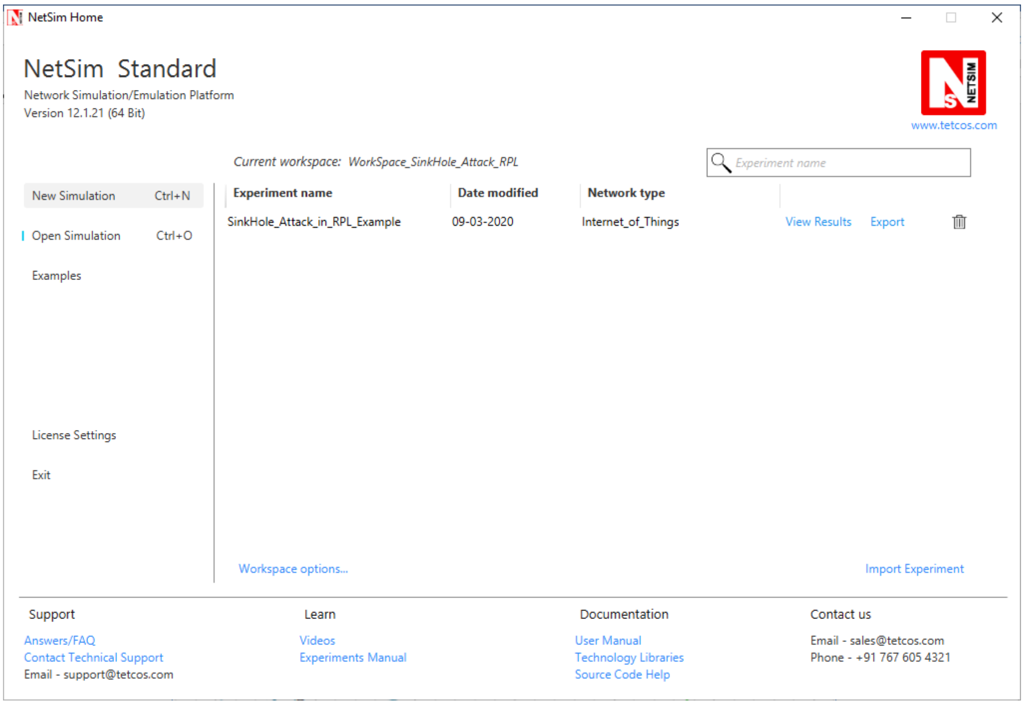


Warning

**Software Version Mismatch**

You are importing a workspace from 32 build of NetSim into a 64 build of NetSim. After import, reset binaries for this workspace, and then rebuild your code if you have made any changes to the source codes.

10. Go to NetSim home page, click on **Open Simulation**, Click on **SinkHole_Attack_in_RPL_Example**.



NetSim Home

NetSim Standard

Network Simulation/Emulation Platform

Version 12.1.21 (64 Bit)

www.tetcos.com

*Current workspace: WorkSpace_SinkHole_Attack_RPL*

*Experiment name*

| | |
|---|---|
| New Simulation | Ctrl+N |
| Open Simulation | Ctrl+O |
| Examples | |
| License Settings | |
| Exit | |

| Experiment name | Date modified | Network type | | |
|---|---|---|---|---|
| SinkHole_Attack_in_RPL_Example | 09-03-2020 | Internet_of_Things | View Results | Export |

Workspace options...

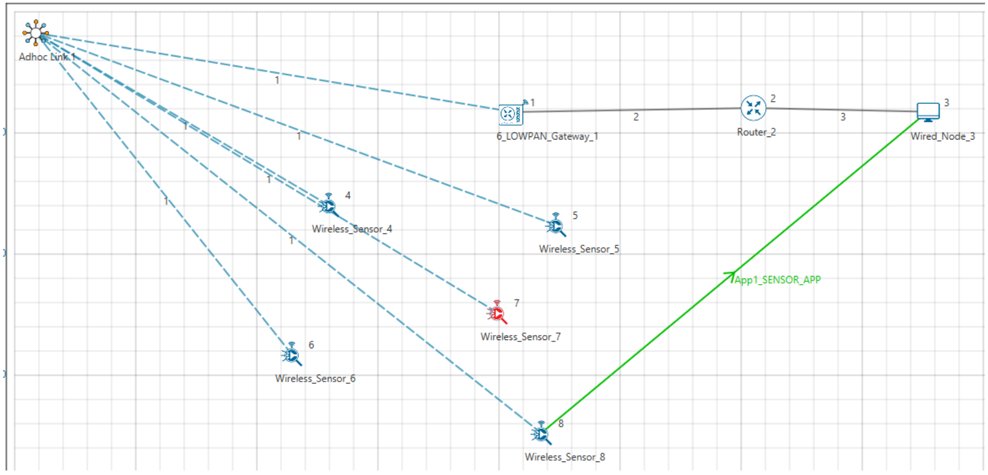
Import Experiment

| Support | Learn | Documentation | Contact us |
|---|---|---|---|
| Answers/FAQ | Videos | User Manual | Email - sales@tetcos.com |
| Contact Technical Support | Experiments Manual | Technology Libraries | Phone - +91 767 605 4321 |
| Email - support@tetcos.com | | Source Code Help | |

## Settings that were done to create the network scenario for SinkHole Attack:

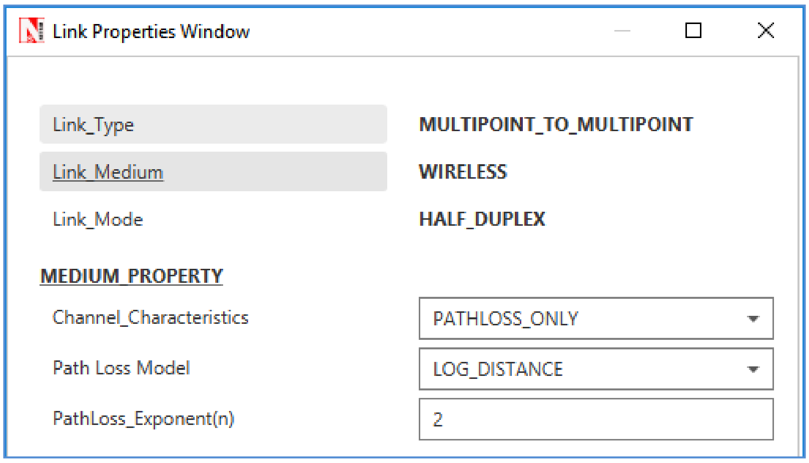
1. Create a network scenario in **IoT (Internet of Things) with UDP running in the Transport Layer and RPL in Network Layer.**

2. For example, you can create a scenario as shown in the following screenshot:



### Environment Properties:

- Right click on the Adhoc link icon and select Properties.
- Select the Channel Characteristics and set the parameters accordingly.



| | |
|---|---|
| Link_Type | MULTIPOINT_TO_MULTIPOINT |
| Link_Medium | WIRELESS |
| Link_Mode | HALF_DUPLEX |

MEDIUM_PROPERTY

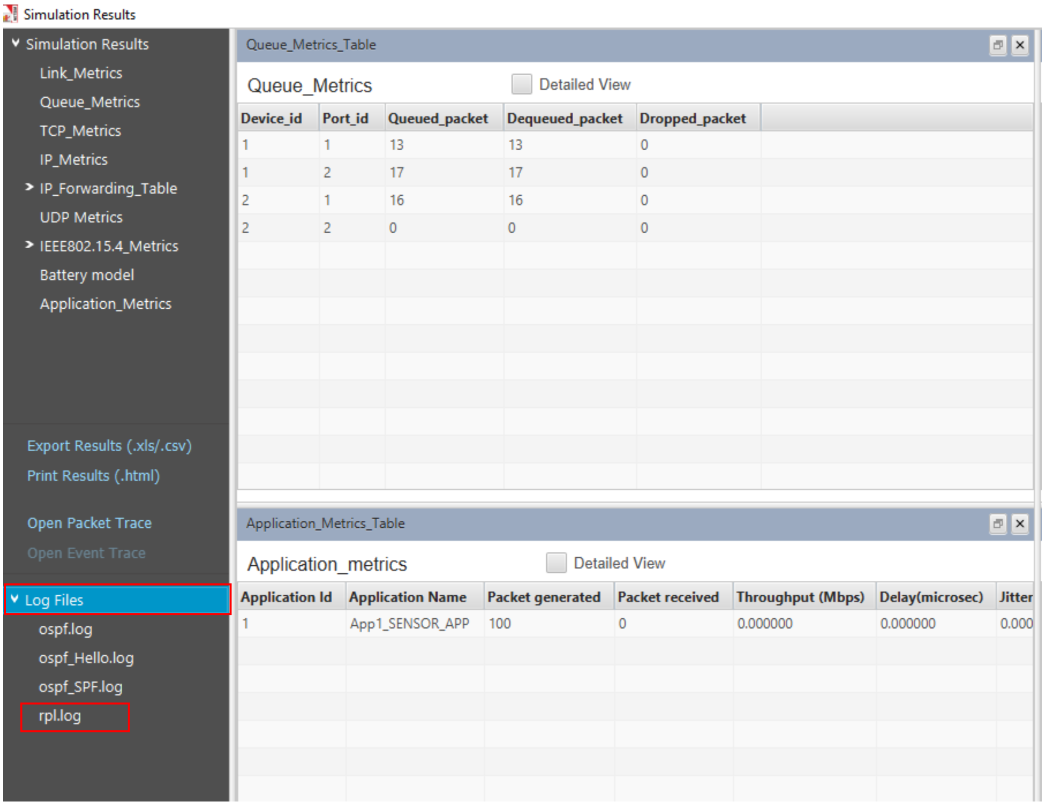
| | |
|---|---|
| Channel_Characteristics | PATHLOSS_ONLY |
| Path Loss Model | LOG_DISTANCE |
| PathLoss_Exponent(n) | 2 |

## Output

Open **rpllog.txt** file from simulation results window,then you will find the information about DODAG formation.

For every DODAG, 6LoWPAN Gateway is the root of the DODAG

- Root is 1 with rank = 1 (Since the Node Id_1 is 6LoWPAN Gateway)
- Wireless_Sensor_Node_7(Malicious Node)



Queue_Metrics □ Detailed View

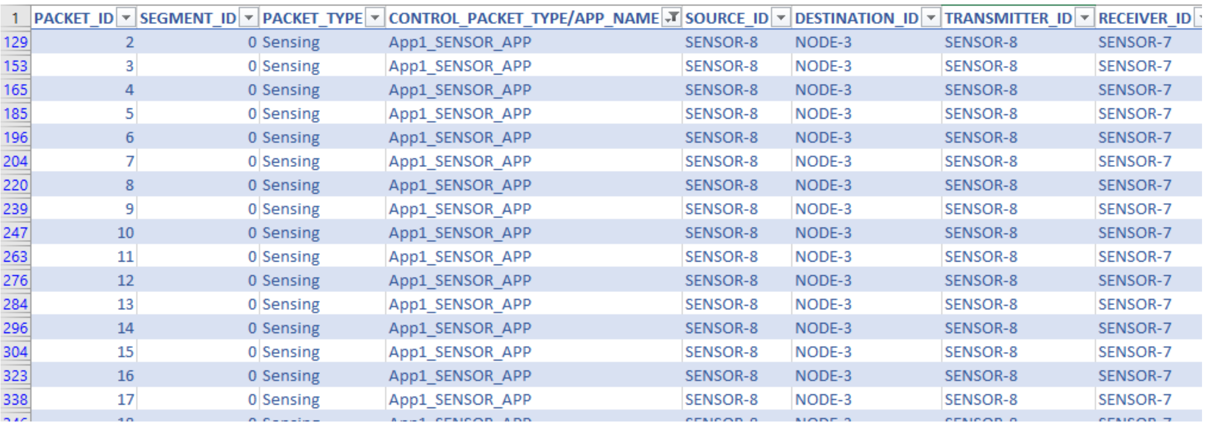
| Device_id | Port_id | Queued_packet | Dequeued_packet | Dropped_packet |
|---|---|---|---|---|
| 1 | 1 | 13 | 13 | 0 |
| 1 | 2 | 17 | 17 | 0 |
| 2 | 1 | 16 | 16 | 0 |
| 2 | 2 | 0 | 0 | 0 |

Application_metrics □ Detailed View

| Application Id | Application Name | Packet generated | Packet received | Throughput (Mbps) | Delay(microsec) | Jitter |
|---|---|---|---|---|---|---|
| 1 | App1_SENSOR_APP | 100 | 0 | 0.000000 | 0.000000 | 0.000 |

**Packet is transmitted by node 8(Sensor_8) is received by node 7(Sensor_7) since the node 7 is malicious node it drops the packet. So the Throughput in this scenario is 0.**

Open **Packet trace** file from simulation results window and filter only the data packets now check the **Transmitter_Id and receiver_Id** column. Since the node 7 is malicious node it drops the packet without forwarding it further.



| 1 | PACKET_ID | SEGMENT_ID | PACKET_TYPE | CONTROL_PACKET_TYPE/APP_NAME | SOURCE_ID | DESTINATION_ID | TRANSMITTER_ID | RECEIVER_ID |
|---|---|---|---|---|---|---|---|---|
| 129 | 2 | 0 | Sensing | App1_SENSOR_APP | SENSOR-8 | NODE-3 | SENSOR-8 | SENSOR-7 |
| 153 | 3 | 0 | Sensing | App1_SENSOR_APP | SENSOR-8 | NODE-3 | SENSOR-8 | SENSOR-7 |
| 165 | 4 | 0 | Sensing | App1_SENSOR_APP | SENSOR-8 | NODE-3 | SENSOR-8 | SENSOR-7 |
| 185 | 5 | 0 | Sensing | App1_SENSOR_APP | SENSOR-8 | NODE-3 | SENSOR-8 | SENSOR-7 |
| 196 | 6 | 0 | Sensing | App1_SENSOR_APP | SENSOR-8 | NODE-3 | SENSOR-8 | SENSOR-7 |
| 204 | 7 | 0 | Sensing | App1_SENSOR_APP | SENSOR-8 | NODE-3 | SENSOR-8 | SENSOR-7 |
| 220 | 8 | 0 | Sensing | App1_SENSOR_APP | SENSOR-8 | NODE-3 | SENSOR-8 | SENSOR-7 |
| 239 | 9 | 0 | Sensing | App1_SENSOR_APP | SENSOR-8 | NODE-3 | SENSOR-8 | SENSOR-7 |
| 247 | 10 | 0 | Sensing | App1_SENSOR_APP | SENSOR-8 | NODE-3 | SENSOR-8 | SENSOR-7 |
| 263 | 11 | 0 | Sensing | App1_SENSOR_APP | SENSOR-8 | NODE-3 | SENSOR-8 | SENSOR-7 |
| 276 | 12 | 0 | Sensing | App1_SENSOR_APP | SENSOR-8 | NODE-3 | SENSOR-8 | SENSOR-7 |
| 284 | 13 | 0 | Sensing | App1_SENSOR_APP | SENSOR-8 | NODE-3 | SENSOR-8 | SENSOR-7 |
| 296 | 14 | 0 | Sensing | App1_SENSOR_APP | SENSOR-8 | NODE-3 | SENSOR-8 | SENSOR-7 |
| 304 | 15 | 0 | Sensing | App1_SENSOR_APP | SENSOR-8 | NODE-3 | SENSOR-8 | SENSOR-7 |
| 323 | 16 | 0 | Sensing | App1_SENSOR_APP | SENSOR-8 | NODE-3 | SENSOR-8 | SENSOR-7 |
| 338 | 17 | 0 | Sensing | App1_SENSOR_APP | SENSOR-8 | NODE-3 | SENSOR-8 | SENSOR-7 |
| 346 | 18 | 0 | Sensing | App1_SENSOR_APP | SENSOR-8 | NODE-3 | SENSOR-8 | SENSOR-7 |