

## NetSim Interfacing with Node Red and IBM Watson

**Software Recommended:** NetSim Standard v13.0 (64 bit), Node-RED both on server and client machine.

### Project Download Link:

[https://github.com/NetSim-TETCOS/IoT-Interfacing-with-Nodered-and-IBM-Watson\\_v13.0/archive/refs/heads/main.zip](https://github.com/NetSim-TETCOS/IoT-Interfacing-with-Nodered-and-IBM-Watson_v13.0/archive/refs/heads/main.zip)

### Objective:

Interfacing NetSim with IBM node red and IBM Watson IoT cloud platform.

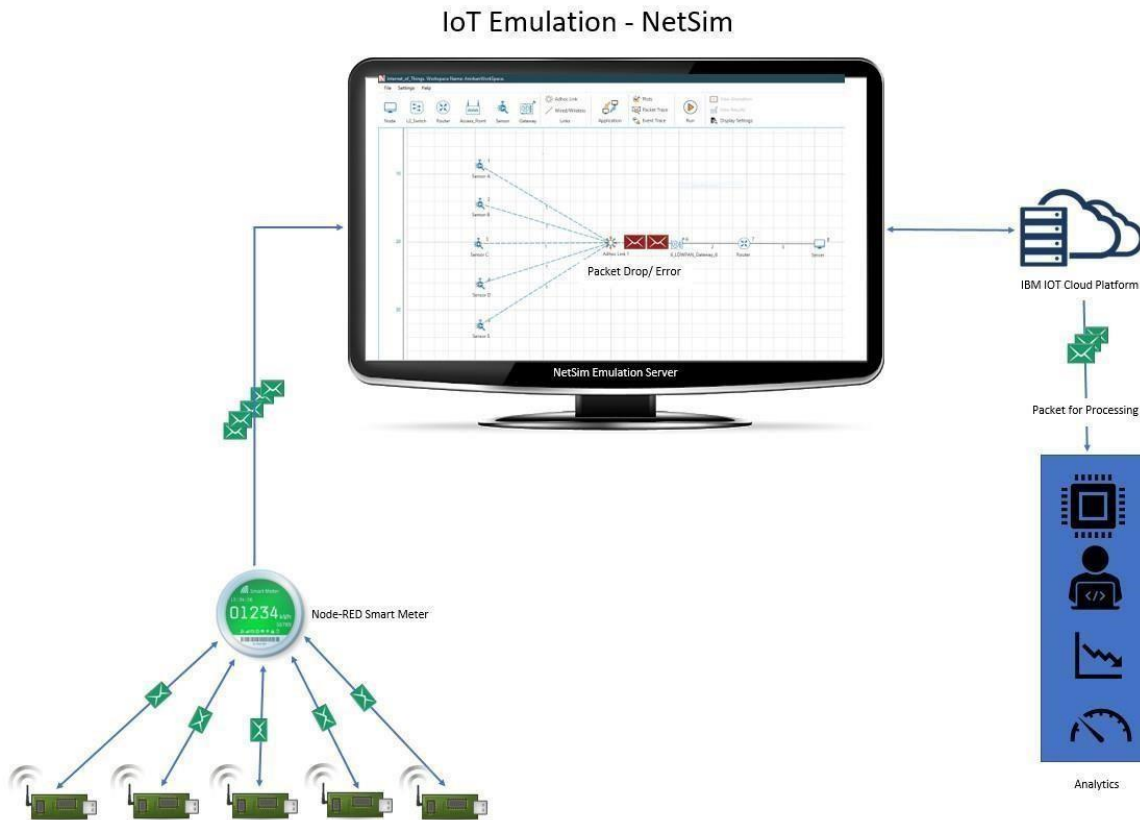
### About Node-RED and IBM- Watson QuickStart

- a. **Node-RED** is a programming tool for wiring together hardware devices, APIs and online services in new and interesting ways. It provides a browser-based editor that makes it easy to wire together flows using the wide range of nodes in the palette that can be deployed to its runtime in a single-click.

Node-RED is built on Node.js, taking full advantage of its event-driven, nonblocking model. This makes it ideal to run at the edge of the network on low-cost hardware such as the Raspberry Pi as well as in the cloud

- b. **Quickstart** is a way of getting a single device sending data to Watson IoT Platform that you can visualize in your browser. No sign up is required, you can see how easy it is to connect your device and, if you want to continue after QuickStart, you can sign up, add security to your device and you are ready to go.

## High Level Connectivity Diagram



- IBM node red 'virtual sensors' are mapped to sensors in NetSim.
- The traffic sent by the IBM Node-RED virtual sensor is routed inside NetSim and sent from the sensors to the sink in NetSim's virtual network.
- From the sink it is sent to IBM Watson IoT platform cloud server.

### Step by step implementation.

#### System 1 Setup: Sensor server and NetSim Emulation Server Installation Node-RED Installation and its working

- Installation of Node Red on Windows: Follow the steps on how to install Nodered in windows, at <https://nodered.org/docs/getting-started/windows>
- Running Node-RED and configuring Sensor server:
- Run Node-RED through cmd window
- Open browser <http://127.0.0.1:1880/?#flow/>
- Install Node-red packages - commands
  - i. npm Install Node-RED-contrib-scx-ibmiotapp
  - ii. npm Install Node-RED-dashboard package

iii. npm install node-red-contrib-ibm-watson-iot

### Setting up Sensor - Server

- Import Server.json file i.e Menu > Import > Browse > <Select server.json> from from the downloaded project folder if you want to have sensor server
- Configure the device present in the flow graph in Figure 1.1,

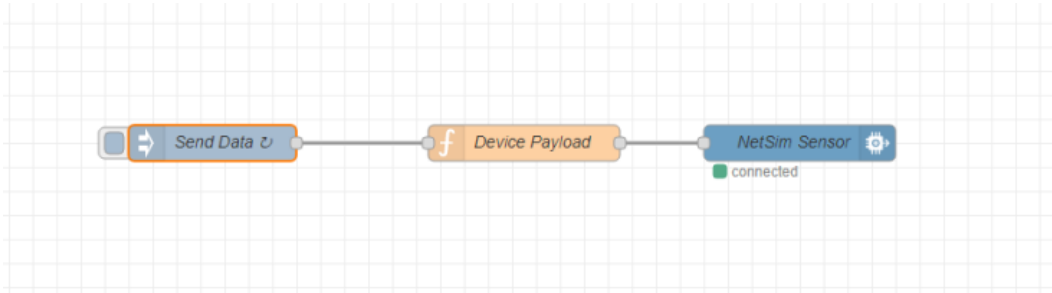


Figure 1.1 Flow design for Multiple sensors

Users can also use a smart meter to send the data. Which accepts the following as input and here is a format to give file as input as shown in Figure 1.3

- HTTP
- USB
- FILE

The screenshot shows a dialog box titled 'Edit smartmeter node > Add new smartmeter-connection config node'. At the top right are 'Cancel' and 'Add' buttons. Below is a 'Properties' section with a gear icon and a document icon. The 'Source type' is set to 'File' in a dropdown menu. The 'Filename' field contains the text 'for example: /tmp/data.json'.

Figure 1.3

Figure 1.4 Sensor Data: Generating 1Packet/second which accepts decimal values

- Since we are now configuring a virtual sensor, the device payload is set by writing a function in Device Payload in flow chart as Figure 1.5 Sensor Payload

Function:

```
var counter1 = context.get('counter1')||0;
counter1 = counter1+1; if(counter1
> 1000) counter1 = 0; context.set('counter1',counter1);

// Create MQTT message in JSON msg = {payload:
JSON.stringify({d:"Dummy_Data" : counter1}}); return msg;
```

When having multiple sensors in the scenario, users can generate Payload by specifying port number for each sensors.

Users need to add ***msg.port=<port number>;*** in the payload function



Figure 1.5 Sensor Payload

### IOT Emulation using virtual Smart-meter using IBM Node-RED

Users can also use Node-RED Smart-meter to generate payload instead of writing virtual sensor function.

Node-RED requires additional installation of packages related to smart-meter.

Node-RED Node, that reads and parses the data from smartmeter devices. Supports for example Hager eHz Energy Meter, EMH Energy Meter, EFR SmartGridHub, Siemens 2WR5, Elster AS1440, Iskraemeco MT174, Itron EM214 Typ 720 etc.

For additional information on how to install smart-meter and use that as payload generator look into <https://flows.nodered.org/node/node-red-contrib-smartmeter>.

### Sending data from real sensor

Users can also use real sensor instead of virtual sensors. i.e. users can connect real sensors to Raspberry Pi and then install Node- red on Raspberry Pi and configure the Node-flow.

While adding function payload users can directly retrieve the real sensor values and send them to cloud.

Here is an example on how users can connect real sensors to IBM Watson IoT Platform.

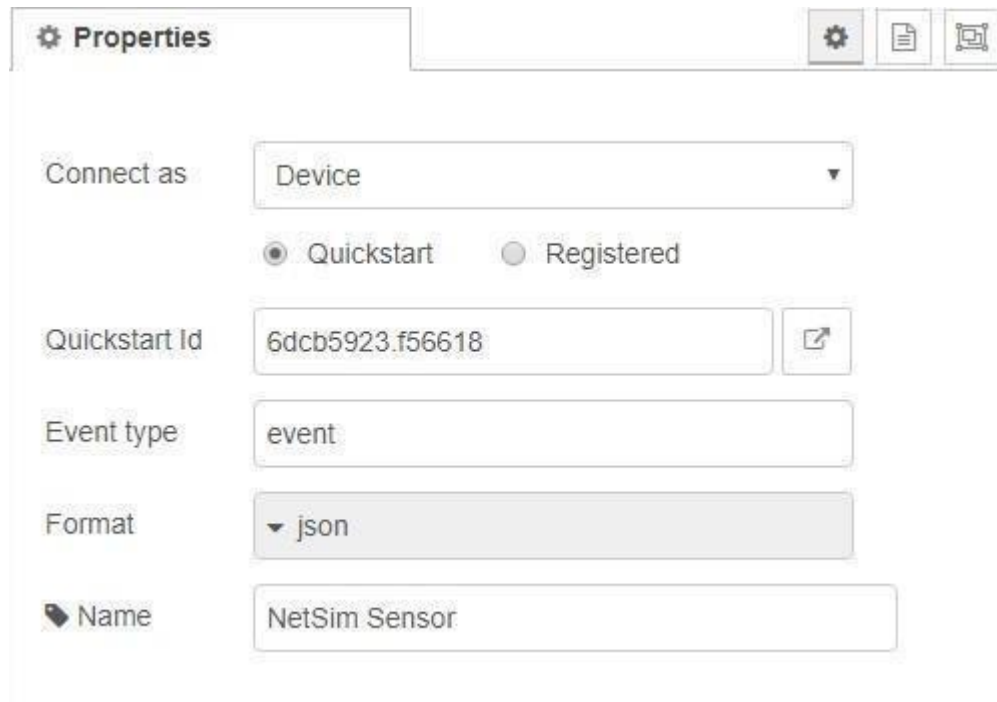
<https://www.hackster.io/madoyon/connect-sensors-to-ibm-watson-iot-platform-083973>

### Encryption and Decryption of sensor data

The packet payload can also be encrypted if required. No encryption is applied to the payload by default. Node-RED nodes uses CryptoJS to encrypt and decrypt messages.

For detail on how to encrypt and decrypt the message users can refer to the examples at <https://flows.nodered.org/node/node-red-contrib-crypto-js>

- Connect NetSim Sensor node to IBM Watson QuickStart IoT Platform



The image shows the 'Properties' panel for a NetSim Sensor node in Node-RED. The panel includes the following fields and controls:

- Connect as:** A dropdown menu currently showing 'Device'.
- Quickstart:** Two radio buttons, with 'Quickstart' selected and 'Registered' unselected.
- Quickstart Id:** A text input field containing '6dcb5923.f56618' and a link icon to its right.
- Event type:** A text input field containing 'event'.
- Format:** A dropdown menu currently showing 'json'.
- Name:** A text input field containing 'NetSim Sensor'.

Figure 1.6 Fig:1.6

- Deploy the Node-RED Flow
- Open the Link icon present in Figure 1.6 to view live sensor data the payload that you set.

### Installation of NetSim Emulator and setting up emulation server.

- Install NetSim as per NetSim Installation Guide and Start NetSim as administrator (Make sure that Emulator licenses are available)
- Open IoT network module and Create a simple scenario with one sensor connecting to cloud as shown in Figure 1.7
- Create Emulation application between Sensor and Cloud (Also users can specify port if known) as shown in Figure 1.8
  - i. Source Real IP: 192.168.0.20 (System running Node Red)
  - ii. Destination Real IP:0.0.0.0 (Mapping traffic to IBM Watson cloud)

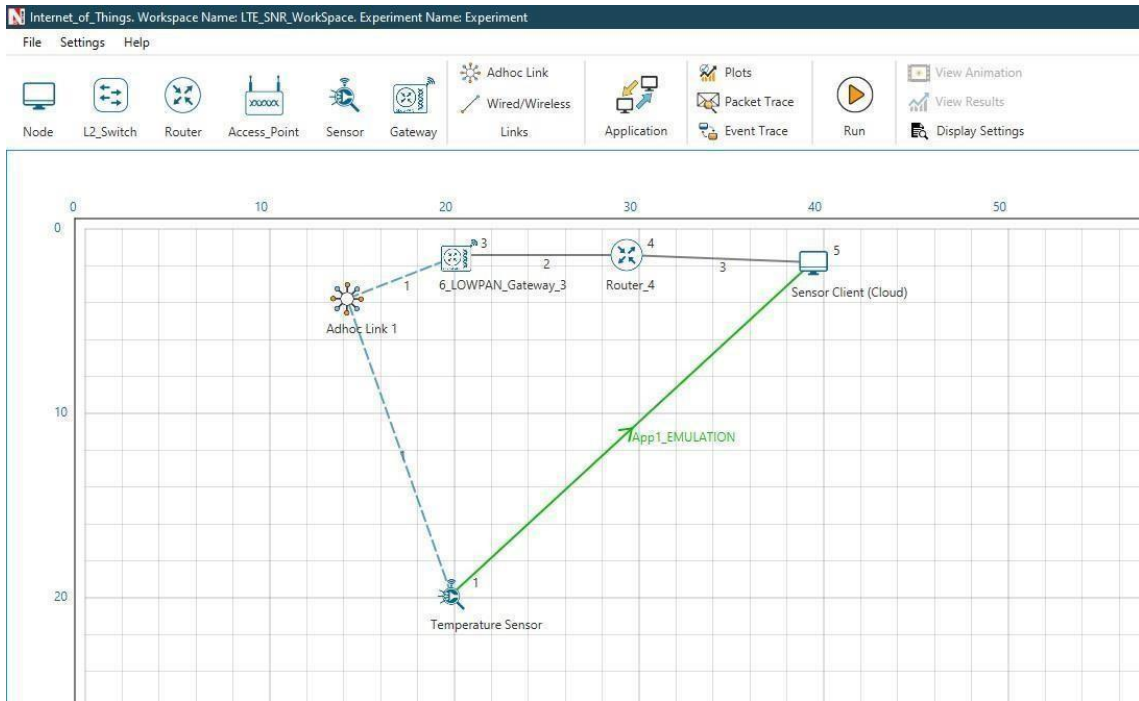


Figure 1.7: Network designed in NetSim

- Also place the sensor and the gateway at suitable distances for pathloss to have an impact on simulation performed.
- Now Run the Simulation for 100s

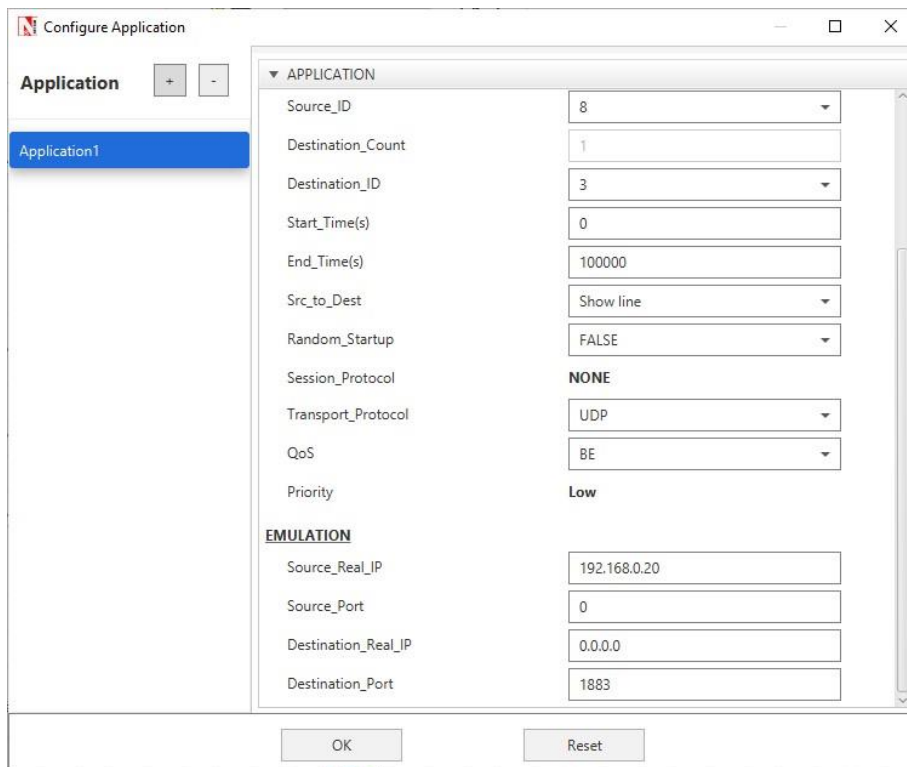


Figure 1.8: NetSim Application Panel

## System 2 Setup: Sensor Client

- Install Node-RED and perform its running as it was explained above for Sensor client
- Design the flow graph as shown in Figure 1.9
- Configure the device present in the flow graph in Figure 1.10, Figure 1.11 and Figure 1.12

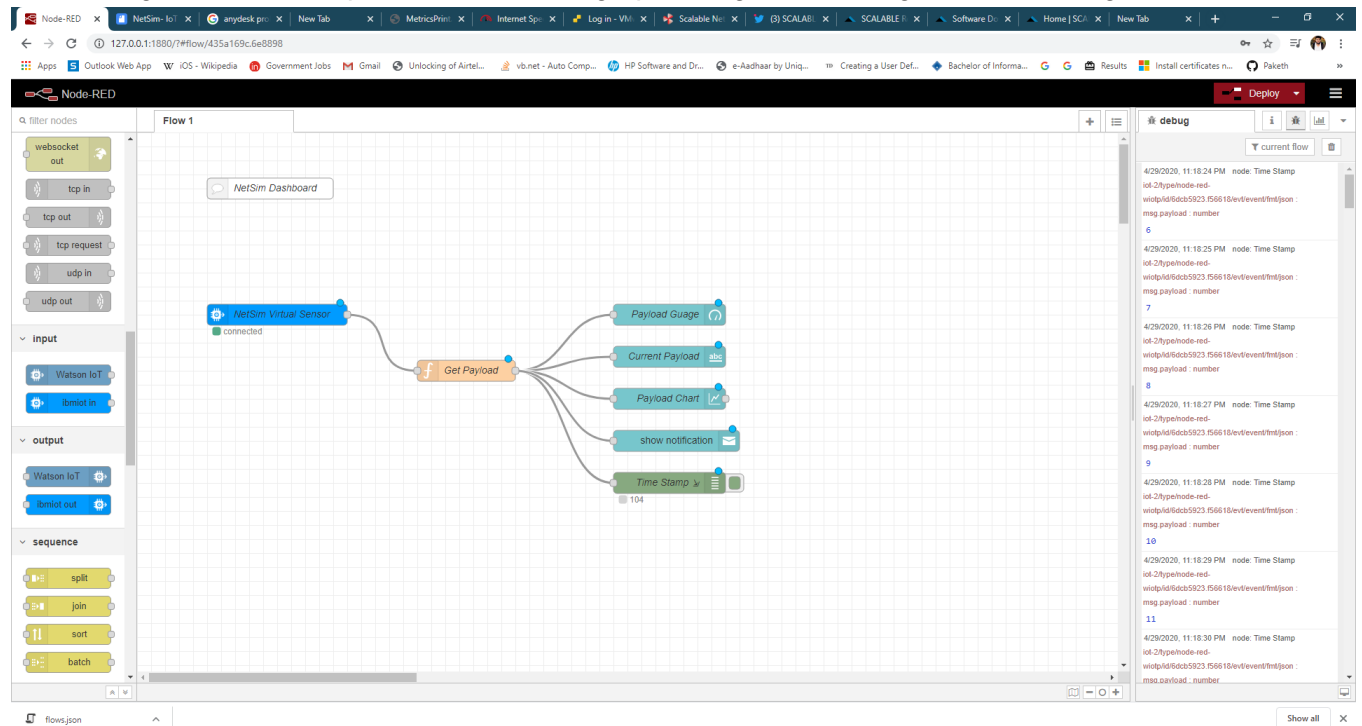


Figure 1.9



d. Configure NetSim Virtual Sensor Node as shown in Fig:1.9

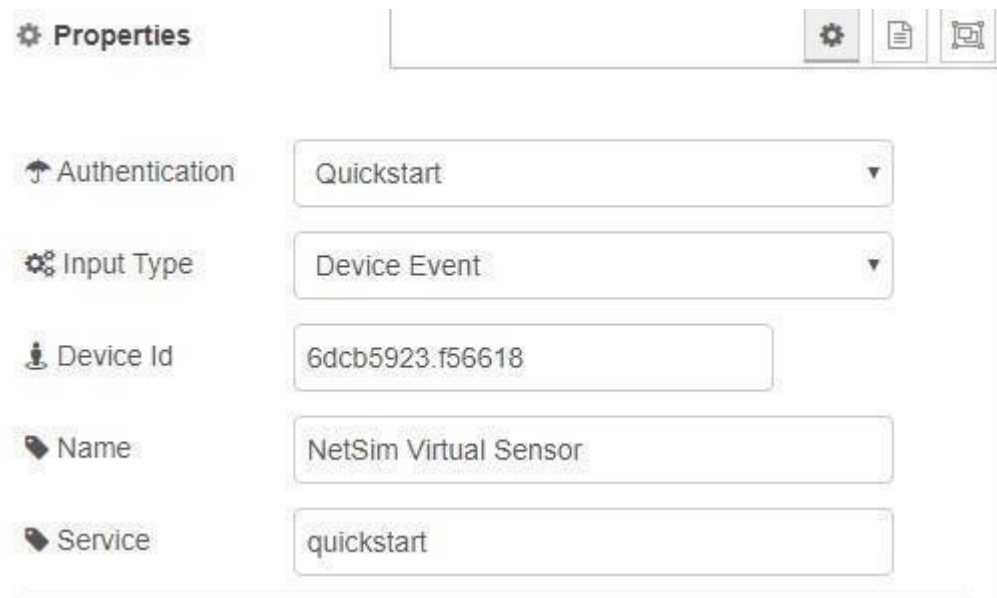


Figure 1.10

e. To access the payload that we generated in Sensor cloud use the Get payload Function as shown in Figure1.11: `msg.payload=msg.payload.d.dummy_data`  
`return msg;`



Figure1.11

f. Enable Debug window using Debug node to access payload to file as shown in Figure 1.12. If you need that payload to be written to a file, then while running Node-RED command to the beginning you can start writing it to a file as

**Node-RED >getpayload.txt**

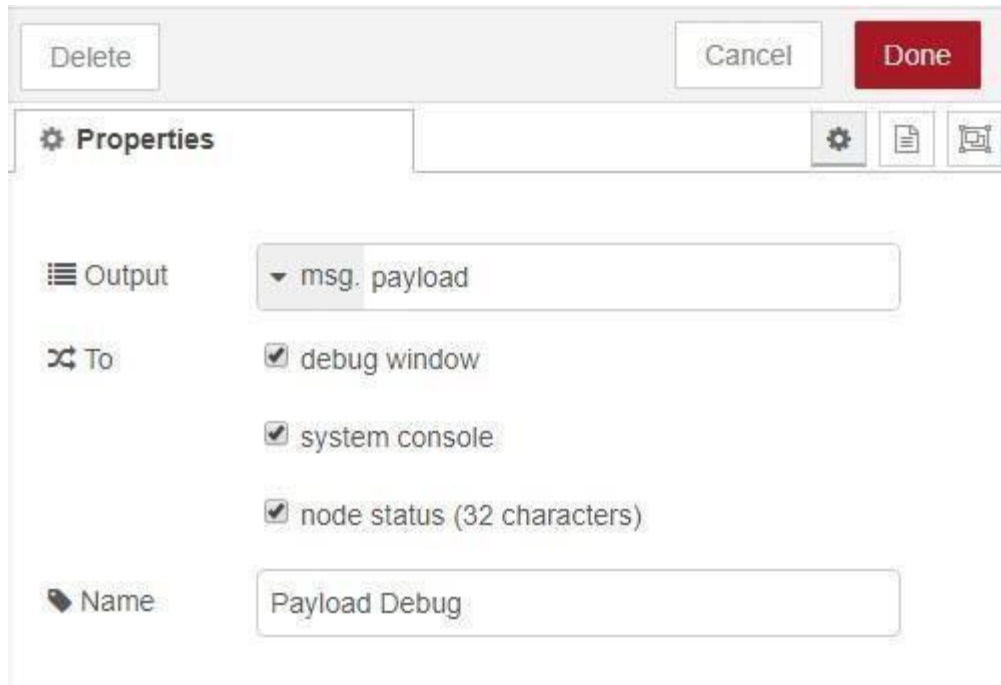


Figure 1.12

- g. Deploy the Node-RED Flow
- h. Make sure that you start receiving the data through the console as shown in Figure 1.13

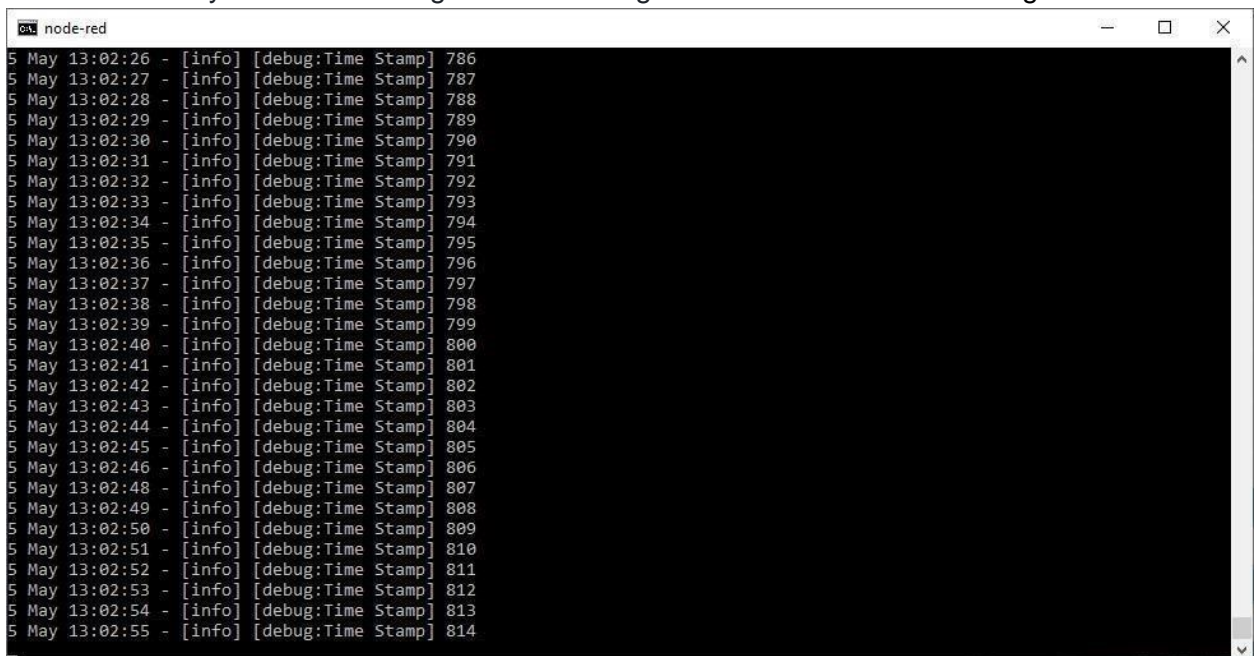


Figure 1.13

## Routing Traffic Through NetSim (Emulation)

Once both the systems are setup and the client starts receiving sensor data that was set in the server, we are ready to perform NetSim Emulation.

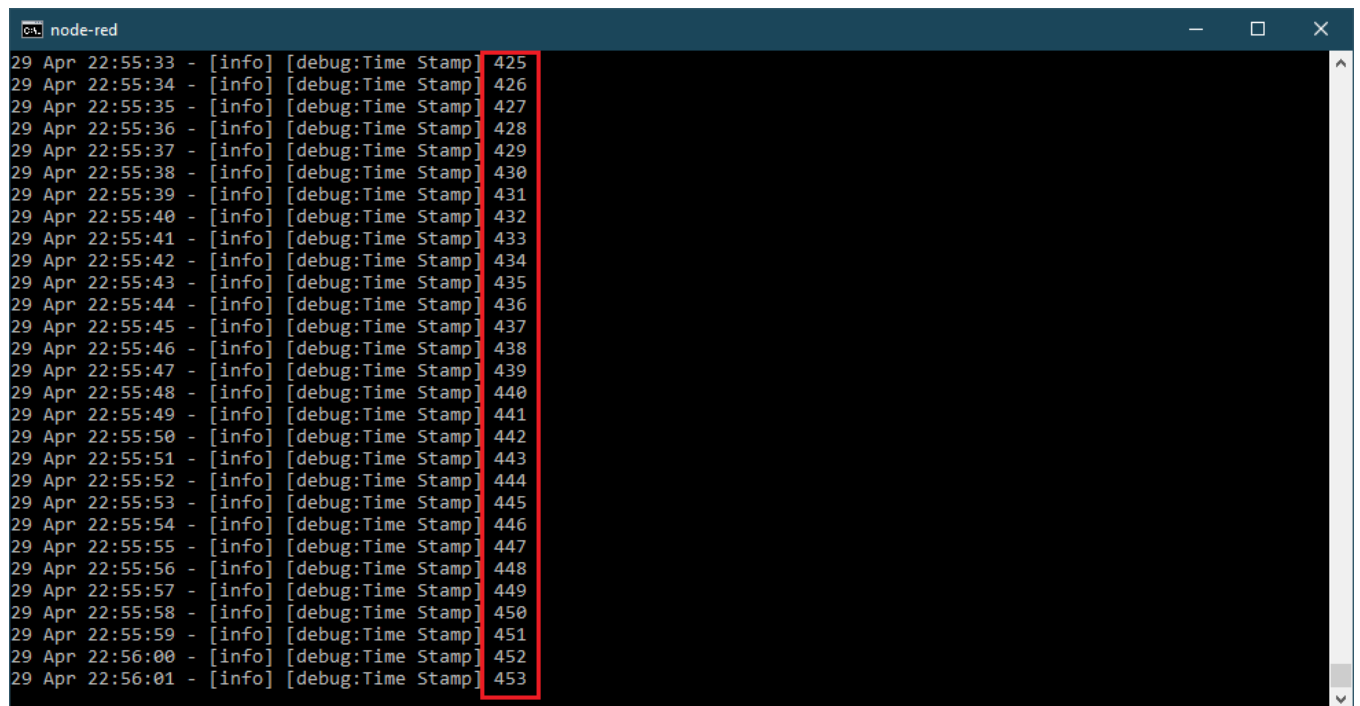
Run NetSim Emulation for all the cases mentioned below and create a log of the debug window when receiving the sensor data.

### Example: Impact of variation of channel conditions and sensor count on packet delivery ratio

**Note:** Since we are performing Emulation the results will vary count of received packets.

Once the emulation is started the Node-red Client CLI starts receiving the emulated packet.

Open Client CLI > Count the number of packets received for every Emulation varying the Pathloss- Exponent.



```
node-red
29 Apr 22:55:33 - [info] [debug:Time Stamp] 425
29 Apr 22:55:34 - [info] [debug:Time Stamp] 426
29 Apr 22:55:35 - [info] [debug:Time Stamp] 427
29 Apr 22:55:36 - [info] [debug:Time Stamp] 428
29 Apr 22:55:37 - [info] [debug:Time Stamp] 429
29 Apr 22:55:38 - [info] [debug:Time Stamp] 430
29 Apr 22:55:39 - [info] [debug:Time Stamp] 431
29 Apr 22:55:40 - [info] [debug:Time Stamp] 432
29 Apr 22:55:41 - [info] [debug:Time Stamp] 433
29 Apr 22:55:42 - [info] [debug:Time Stamp] 434
29 Apr 22:55:43 - [info] [debug:Time Stamp] 435
29 Apr 22:55:44 - [info] [debug:Time Stamp] 436
29 Apr 22:55:45 - [info] [debug:Time Stamp] 437
29 Apr 22:55:46 - [info] [debug:Time Stamp] 438
29 Apr 22:55:47 - [info] [debug:Time Stamp] 439
29 Apr 22:55:48 - [info] [debug:Time Stamp] 440
29 Apr 22:55:49 - [info] [debug:Time Stamp] 441
29 Apr 22:55:50 - [info] [debug:Time Stamp] 442
29 Apr 22:55:51 - [info] [debug:Time Stamp] 443
29 Apr 22:55:52 - [info] [debug:Time Stamp] 444
29 Apr 22:55:53 - [info] [debug:Time Stamp] 445
29 Apr 22:55:54 - [info] [debug:Time Stamp] 446
29 Apr 22:55:55 - [info] [debug:Time Stamp] 447
29 Apr 22:55:56 - [info] [debug:Time Stamp] 448
29 Apr 22:55:57 - [info] [debug:Time Stamp] 449
29 Apr 22:55:58 - [info] [debug:Time Stamp] 450
29 Apr 22:55:59 - [info] [debug:Time Stamp] 451
29 Apr 22:56:00 - [info] [debug:Time Stamp] 452
29 Apr 22:56:01 - [info] [debug:Time Stamp] 453
```

Here are approximate results noted, which may vary for different system and multiple emulation.

Case 1: Sensor count 1

Channel Characteristics	Emulation Application 1 Packet received out of 100
No Pathloss	89

<b>Pathloss - 2</b>	70
<b>Pathloss - 3</b>	58
<b>Pathloss - 3.5</b>	28

Case 2: Sensor count 2

<b>Channel Characteristics</b>	<b>Emulation Application 1</b>	<b>Emulation Application 2</b>
<b>No Pathloss</b>	75	80
<b>Pathloss - 2</b>	73	78
<b>Pathloss - 3</b>	77	63
<b>Pathloss - 3.5</b>	32	27

Case 3: Sensor count 5

<b>Channel Characteristics</b>	<b>App 1</b>	<b>App 2</b>	<b>App 3</b>	<b>App 4</b>	<b>App 5</b>
<b>No Pathloss</b>	63	59	68	44	61
<b>Pathloss - 2</b>	55	50	52	41	51
<b>Pathloss - 3</b>	31	35	28	26	49
<b>Pathloss - 3.5</b>	19	8	12	6	13

Case 4: Sensor count 10

<b>Channel Characteristics</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>
<b>No Pathloss</b>	35	32	39	39	46	43	38	34	45	48
<b>Pathloss - 2</b>	30	28	31	34	39	41	33	20	41	18
<b>Pathloss - 3</b>	9	5	10	8	3	5	2	15	11	5
<b>Pathloss - 3.5</b>	5	0	6	2	0	0	0	8	5	0