Sistemi e Tecnologie Industriali Intelligenti
per il Manifatturiero Avanzato
Consiglio Nazionale delle Ricerche

Node-RED Tutorial
for linked-data

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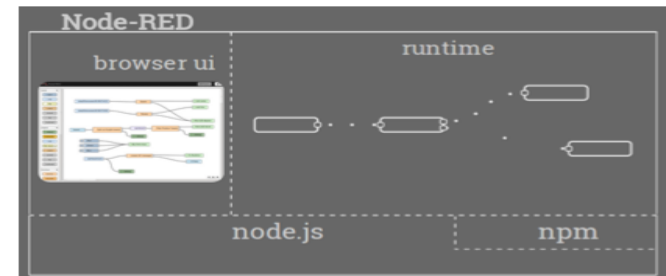
- Node-RED is a powerful tool for building Internet of Things (IoT) applications with a focus on simplifying the 'wiring together' of code blocks to carry out tasks. It uses a visual programming approach that allows developers to connect predefined code blocks, known as 'nodes', together to perform a task. The connected nodes, usually a combination of input nodes, processing nodes and output nodes, when wired together, make up 'flows'. (Link)
- Node-RED provides a web browser- based flow editor, which can be used to create JavaScript functions. Elements of applications can be saved or shared for re-use. The runtime is built on Node.js. The flows created in Node-RED are stored using JSON which can be easily imported and exported for sharing with others. By understanding Node-Red, IoT development can be accelerated without unnecessary coding.



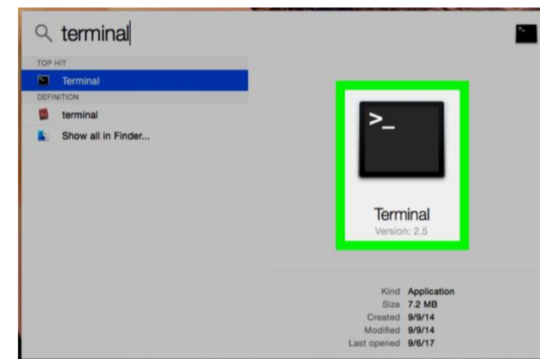
References

- Part of the contents in this tutorial can be found on the Node-Red website: https://nodered.org/
- Installation instructions can be found at: https://nodered.org/docs/getting-started/installation
- Node RED Programming Guide: http://noderedguide.com/
- Introduction to Node-RED: http://www.steves-internet-guide.com/node-red-overview/

Installation of Node-RED

In order to able to work with Node-RED, you should first install node.js. It is recommended the use of Node.js **LTS 8.x or 10.x**. Node-RED no longer supports Node.js 6.x or earlier. You can download the latest version of node.js from its website choosing which operating system you are using:
https://nodejs.org/en/download/

Linux / OsX



Once installed node.js, open the *terminal* window and run the following commands.
To check your version of Node.js

```
node -v
```

The easiest way to install Node-RED is to use the node package manager, npm, that comes with Node.js.
Installing as a global module adds the command node-red to your system path:

```
sudo npm install -g --unsafe-perm node-red
```

Windows

Run the downloaded MSI installer of Node.js. Local administrator rights are needed. Accept the defaults settings when installing. After installation completes, close any open command prompts and re-open to ensure new environment variables are picked up.

Once installed, open a command prompt and run the following command to ensure Node.js and npm are installed correctly.

```
node --version && npm --version
```

You should receive back output that looks similar to:

```
v8.9.0
5.5.1
```

Installing Node-RED as a global module adds the command node-red to your system path.

Execute the following at the command prompt:

```
npm install -g --unsafe-perm node-red
```

If you have installed Node-RED as a global npm package, you can launch node-red in the command prompt (Windows):

```
C:\>node-red
```

or in the terminal (Linux):

```
$ node-red
```

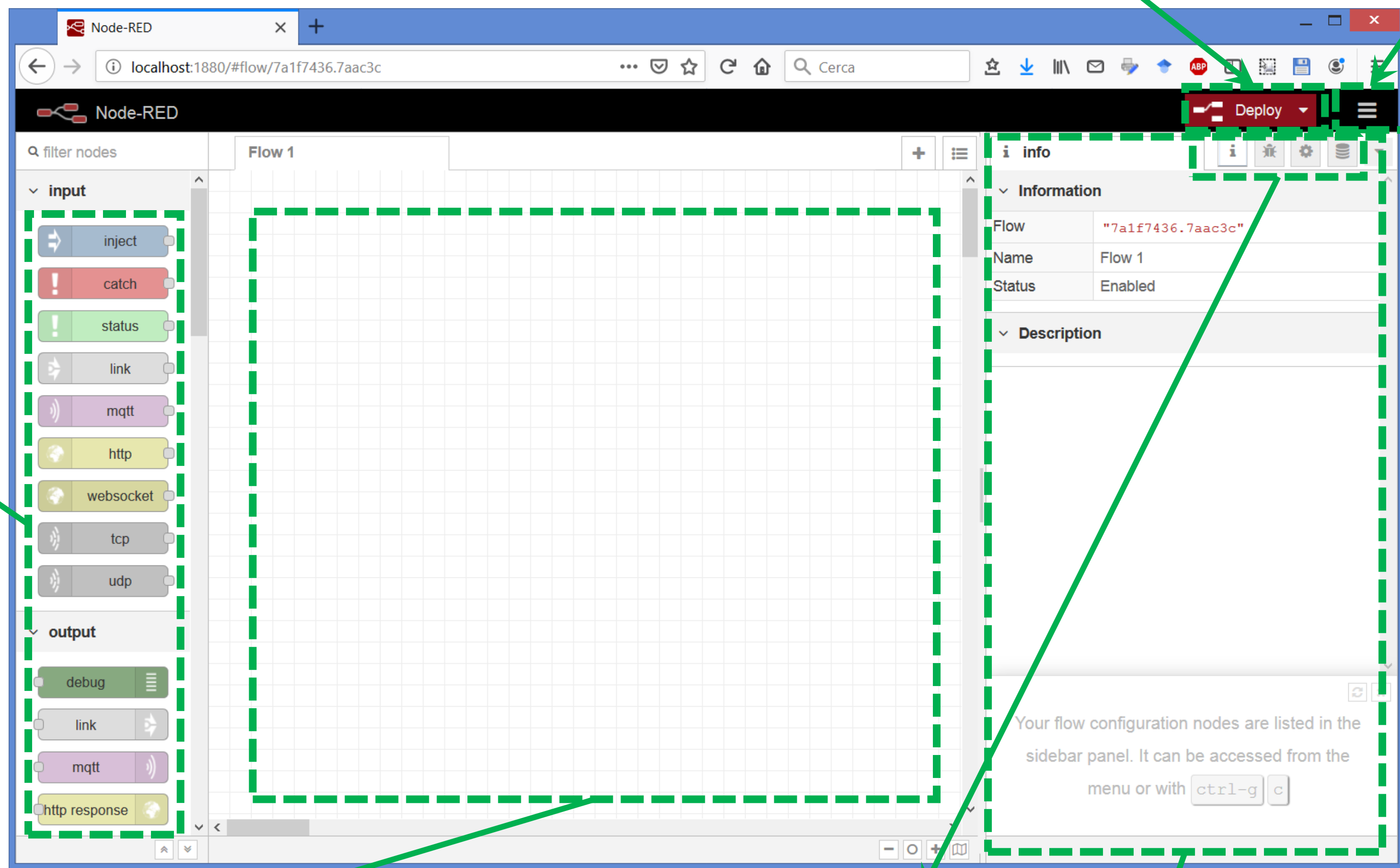
This will output the Node-RED log to the terminal. You must keep the terminal or command prompt open in order to keep Node-RED running. Note that running Node-RED will create a new folder in your %HOMEPATH% folder called .node-red. This is your userDir folder, think of it as the home folder for Node-RED configuration for the current user.

You can then open the Node-RED graphical editor by pointing your browser at http://localhost:1880

Deploy button (to push before executing a flow)

Menu button

Palette of node types



Layout to draw flows

Panel showing contents:

- **Info of selected node**
- **Debug**
- Configuration Nodes
- Context Data

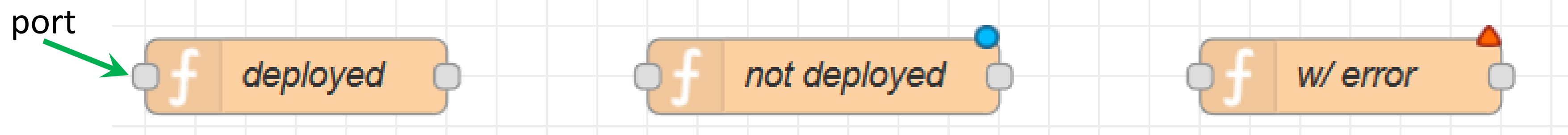
A Node-RED program is developed as a FLOW of messages running through a sequence of NODES. Each node can implement an elaboration of the message.

Nodes

Nodes consist of code that runs in the Node-RED service (javascript .js file), and an HTML file consisting of a description of the node, so that it appears in the node pane with a category, colour, name and an icon, code to configure the node, and help text.

Nodes are added to a flow by simple **drag&drop**.

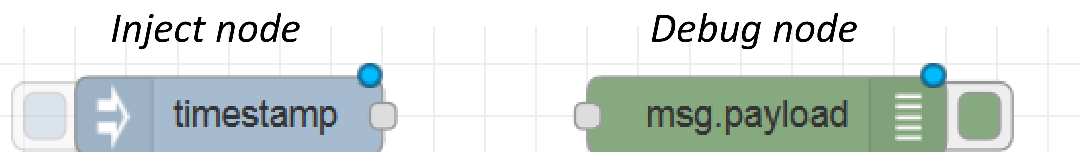
A node can be linked to (multiple) input and (multiple) output via its ports which enable messages to be passed between nodes.



If a node has been change after the latest deployment, then it displays a blue circle above it. If there are errors with its configuration, it displays a red triangle.

Some nodes include a button on either its left or right edge. These allow some interaction with the node from within the editor. The **Inject** and **Debug** nodes are the only core nodes that have buttons.

Inject node *Debug node*



A node configuration can be edited by double clicking on the node, or pressing Enter when the workspace has focus. If multiple nodes are selected, the first node in the selection will be edited.

The node edit dialog has typically three sections: Properties, Description, Appearance. The Properties section is used to set what the node does.

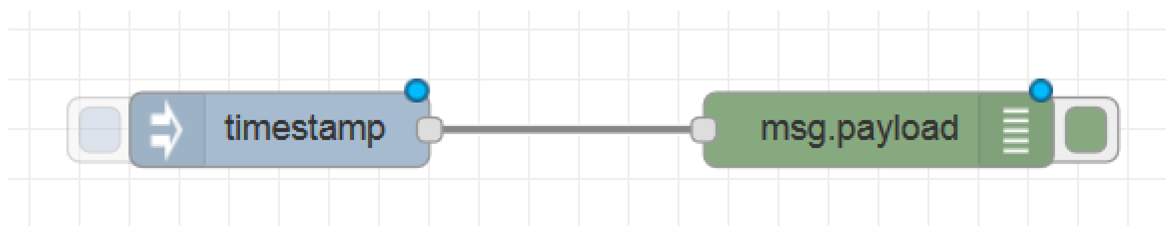
Wires define the connections between node input and output endpoints in a flow.

They (typically) connect the output endpoints of nodes to inputs of downstream nodes indicating that messages generated by one node should be processed by the connected node next.

It is possible to connect more than one node to an endpoint using wires. It is also possible to connect downstream nodes to upstream nodes to form loops.

When multiple nodes are connected to an output endpoint, messages are sent to each connected node in turn in the order they were wired to the output.

When more than one node output is connected to an input endpoint, messages from any of those nodes will be processed by the connected node when they arrive.



A simple flow generating a timestamp that is received by a debug node.

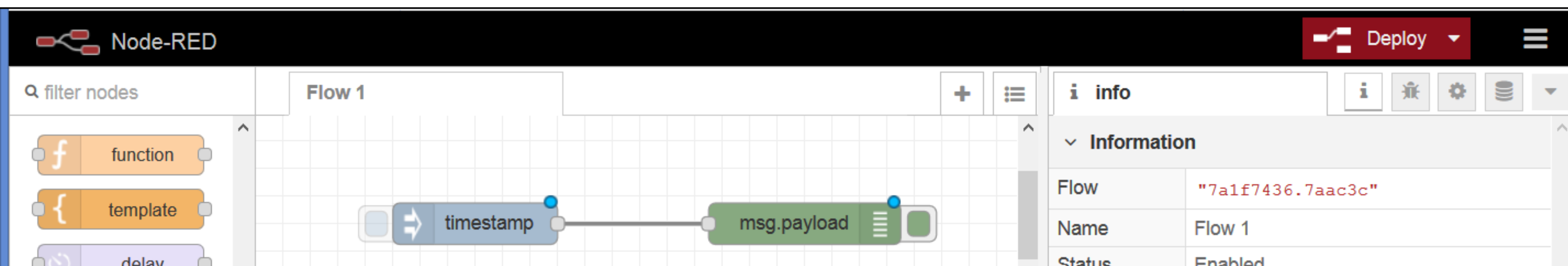
How to create wires?

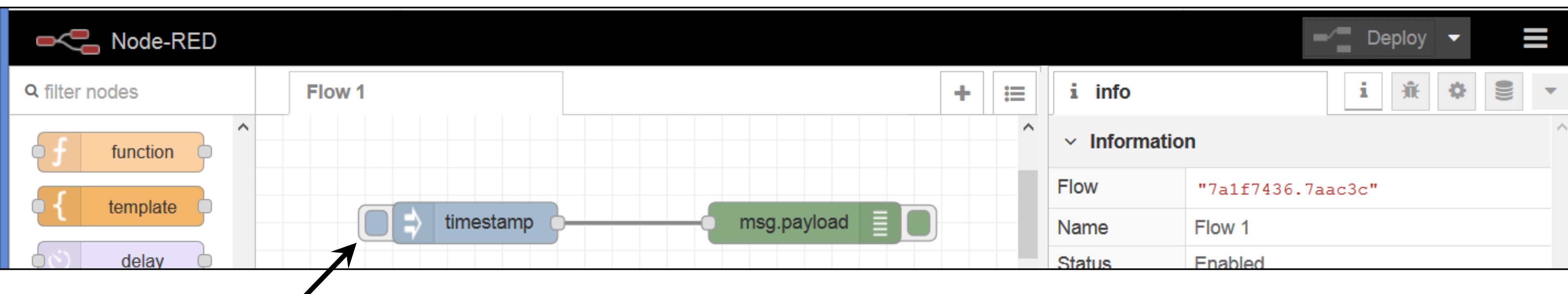
Left-click on an output node port and, while holding down the mouse button, move to the destination input node port. Release the mouse button.

Flow Deployment is needed before executing the flow itself.

The Deploy button is on the top right corner and changes colour from grey to red when any change has been made to a flow to indicate that in it needs to be deployed.

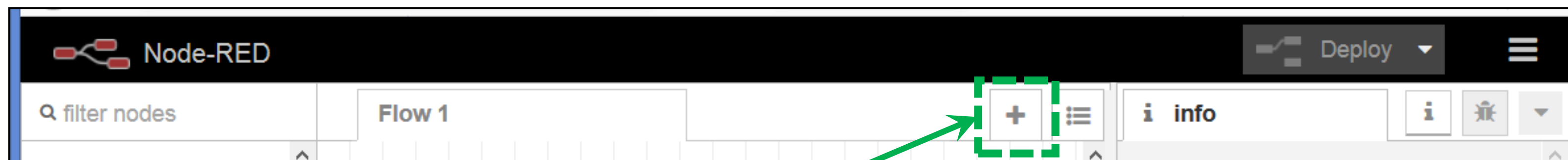
After deployment the flow can be run, e.g. clicking on the button of an Inject node.





Active button of Inject node

Create a Flow: click on the '+' tab



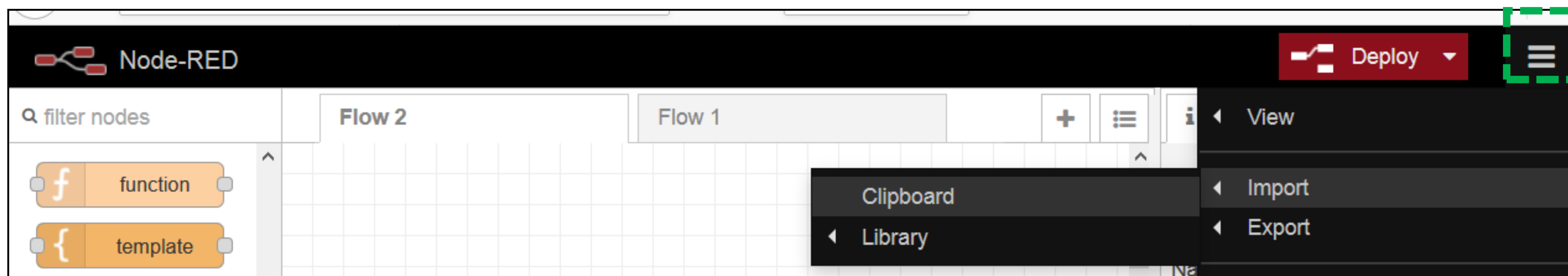
Delete a Flow: double-click on the flow tab and press the button «Delete»

Rename a Flow: double-click on the flow tab, change the name and press the button «Done»

Node-RED
Deploy
filter nodes
Flow 2
function
template
delay
trigger
comment
http request
tcp request
Edit flow: Flow 2
Delete
Cancel
Done
Name
Flow 2
Status
Enabled
Description
h1 h2 h3 B I
1
info
Information
Flow "86eeee9d9.d72b68"
Name Flow 2
Status Enabled
Description

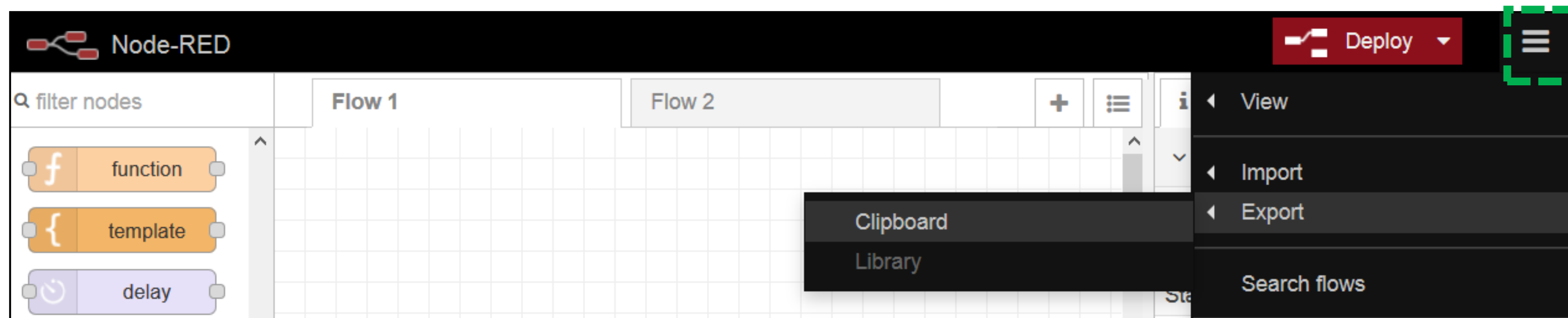
double-click on the flow tab

Import a Flow: click on the main menu and select «Import», «Clipboard»



Then copy&paste the flow or select an input Json file

Export a Flow: click on the main menu and select «Export», «Clipboard»



Then copy the flow or download it as a Json file.

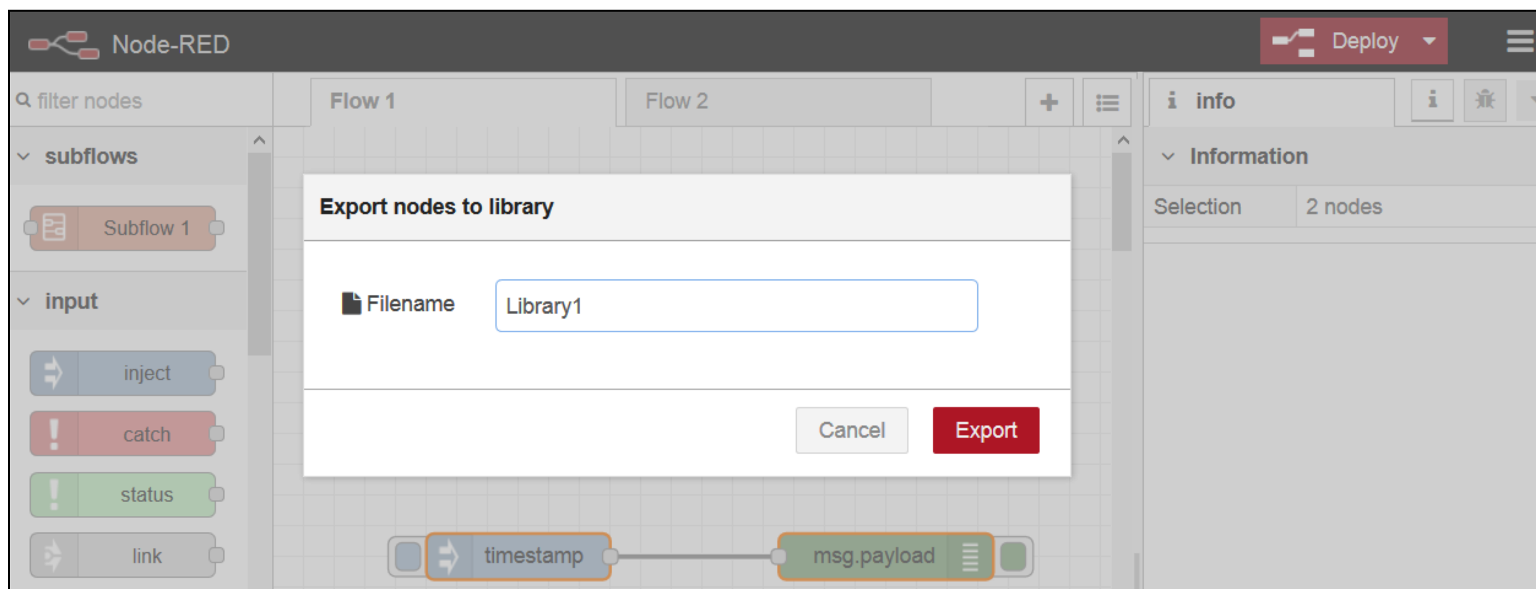
Node-RED
Deploy
filter nodes
Flow 1
Flow 2
info
function
template
delay
trigger
comment
http request
tcp request
switch
change
range
Export nodes
Export to clipboard
selected nodes
current flow
all flows

":"","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"false","x":580,"y":280,"wires":[]},{"id":"a10dcc25.7cd098","type":"inject","z":"7a1f7436.7aac3c","name":"","topic":"","payload":"","payloadType":"date","repeat":"","crontab":"","once":false,"onceDelay":0.1,"x":340,"y":280,"wires":[["f2ca0394.924ca"]]}]

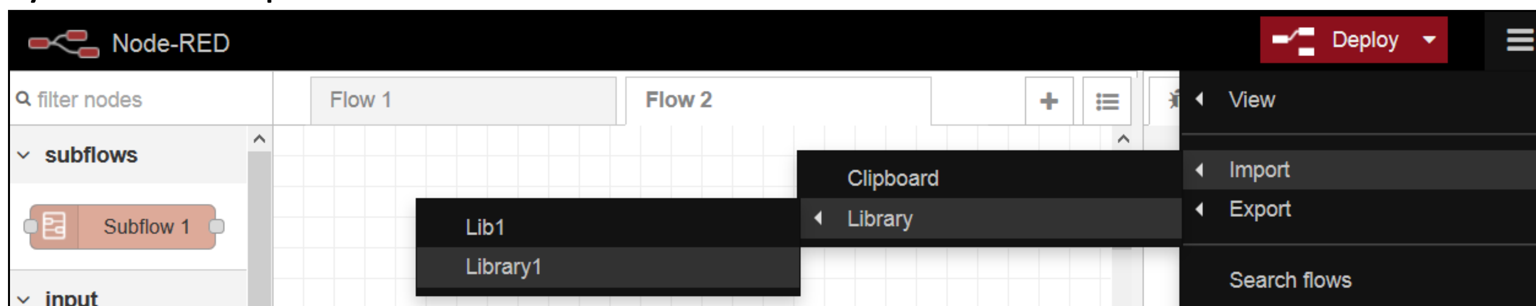
compact
formatted
Cancel
Download
Export to clipboard
Information
Flow "7a1f7436.7aac3c"
Name Flow 1
Status Enabled
Description

Libraries can be created to save a flow or function for reuse it in another flow .

Save a flow to a library: select the relevant nodes in the flow, then click on the main menu > **Export > Library**. Assign a name to the library



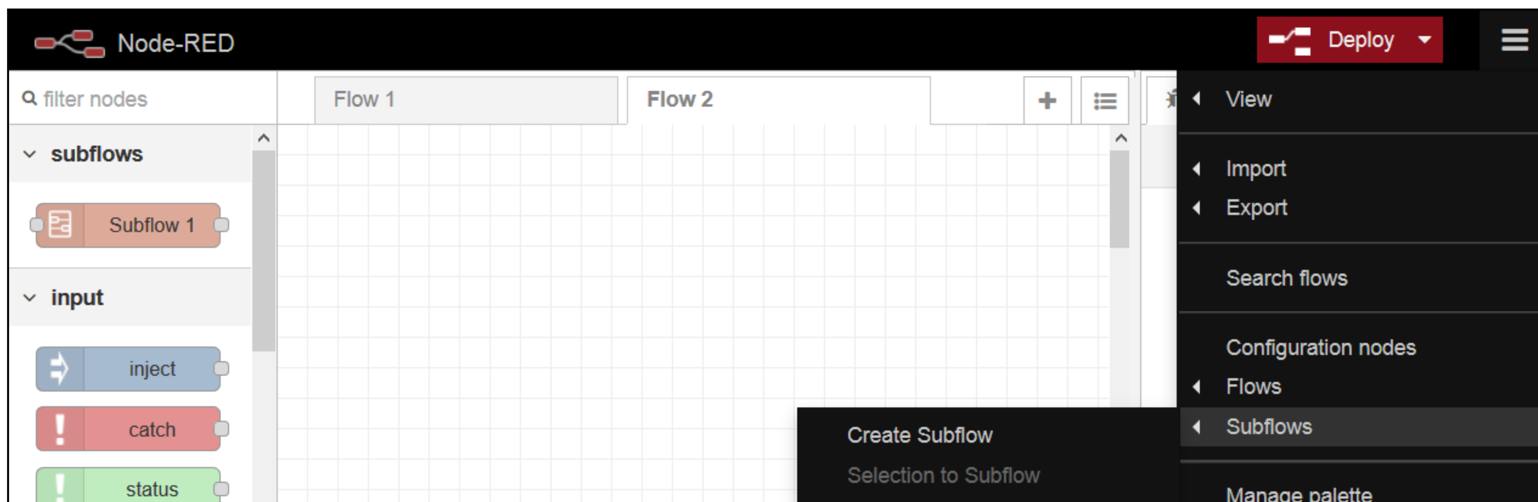
Import a flow from a library: click on the main menu > **Import > Library**. Click on the chosen library name and place the nodes in the flow.



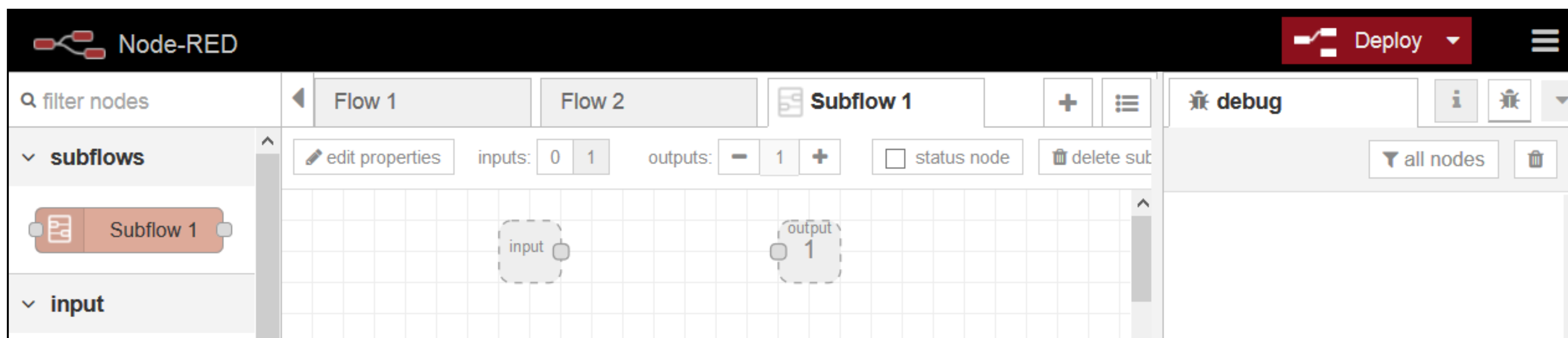
A Subflow is an aggregation of nodes and wires with input and output ports.

The creation of subflows useful to reuse flows and keep the overall flow manageable.

Creat a subflow: click on the main menu > **Subflows > Create Subflow**. Assign a name to the library



Subflows are available in the Palette and can be later added to another flow like a simple node.



A Node-RED flow works by passing messages between nodes.

The messages are simple **JavaScript objects** that can have any set of properties.

The message is passed in as an object called **msg**. Messages usually have a **payload property** (**msg.payload**), i.e. the default property containing the body of the message.

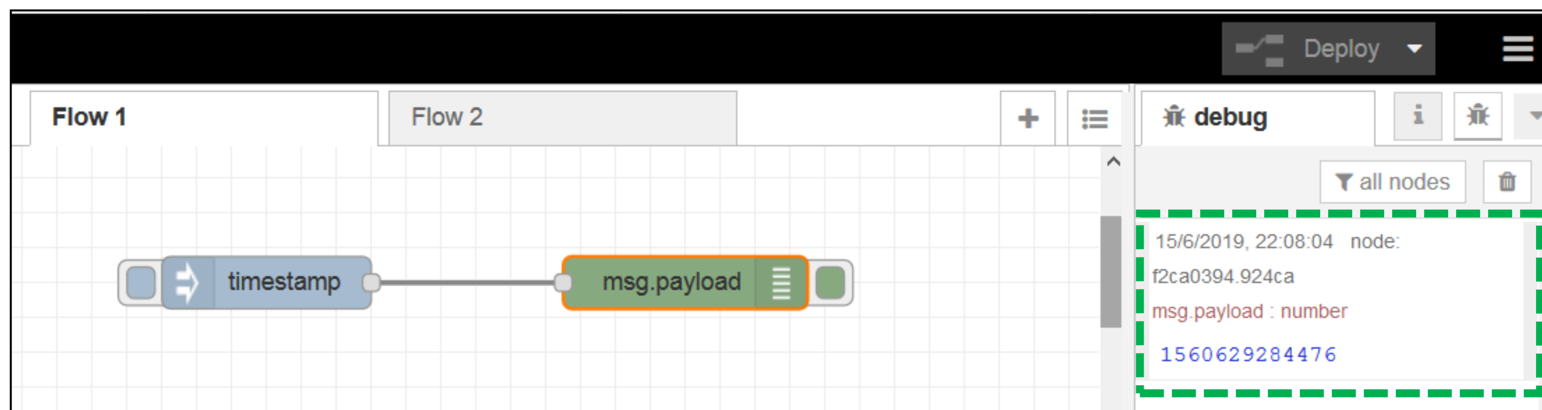
Node-RED also adds a property called _msgid to each message, i.e. an identifier of the message.

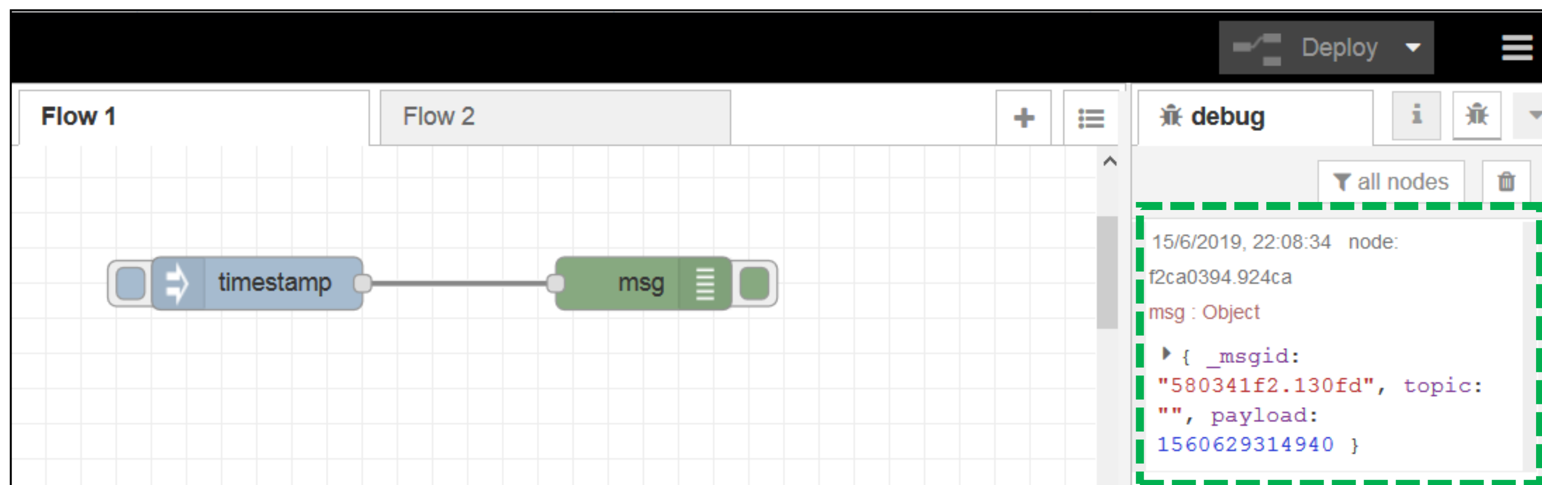
The value of a property can be typically any valid JavaScript type, such as:

- Boolean - true, false
- Number - e.g. 0, 123.4
- String - "hello"
- Array - [1,2,3,4]
- Object - { "a": 1, "b": 2}
- Null

The structure of a message can be better understood if it is passed to a Debug node. Thus, the contents of the message can be viewed in the Debug sidebar.

By default, the Debug node will display the **msg.payload** property, but it can be configured to display any property or the whole message.





When you hover over any element in Debug, a set of buttons appear on the right:

copies the path to the selected element to your clipboard.

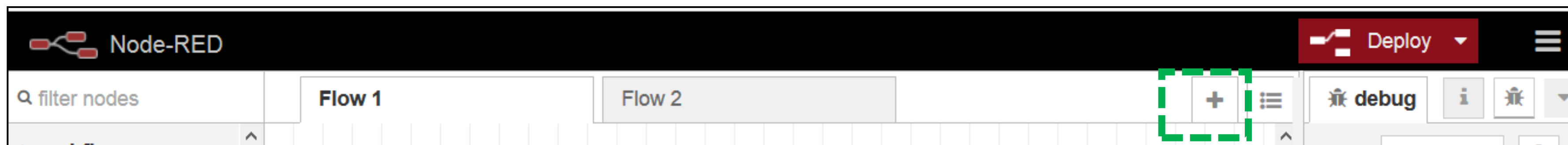
copies the value of the element to your clipboard as a JSON string.

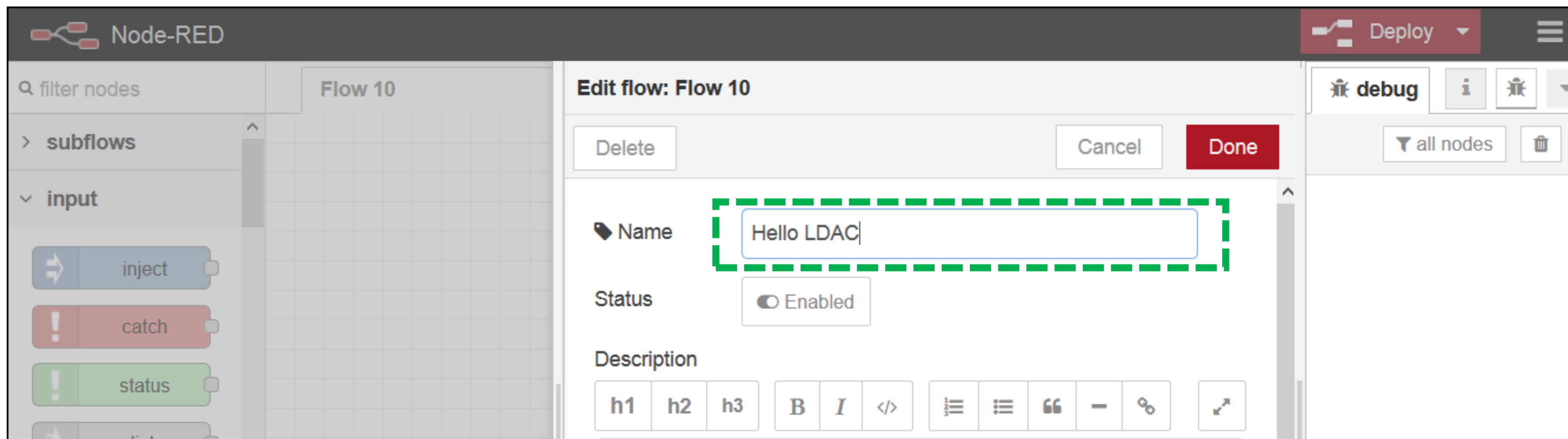
pins the selected element so it is always displayed. When another message is received from the same Debug node, it is automatically expanded to show all pinned elements.

Example: Hello LDAC Summer School!

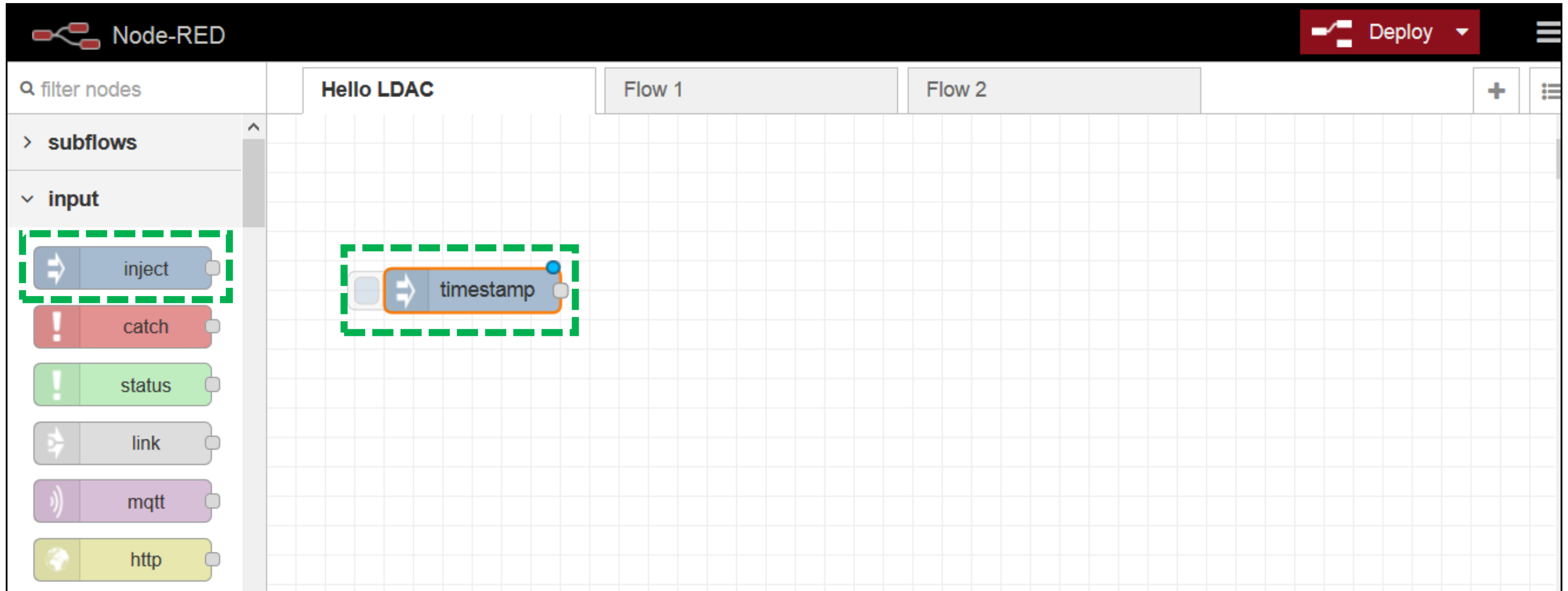
Create a simple routine that prints the message 'Hello LDAC Summer School!'
(Note: several alternative options are possible)

1. Create a new Flow and rename it





2. Add Inject node (from input nodes)



3. Add Change node (from function nodes)

4. Add Debug node (from output nodes)

Node-RED
Deploy

filter nodes
udp
output
debug
link
mqtt
http response
websocket
tcp
udp
function

Hello LDAC
Flow 1
timestamp
Set message payload
msg.payload

Edit debug node
Delete
Cancel
Done
Properties
Output: msg. payload
To: debug window (checked), system console (checked), node status (32 characters)
Name: Debug msg.payload

5. Connect wires and deploy

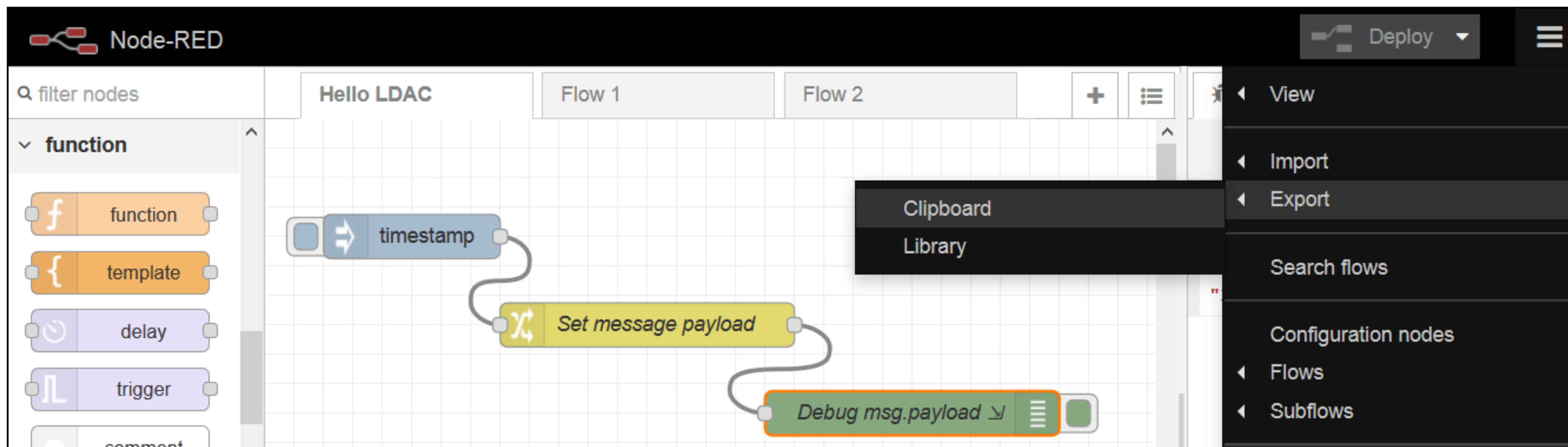
Node-RED
Successfully deployed
Deploy
filter nodes
Hello LDAC
debug
all nodes
udp
output
debug
link
mqtt
http response
websocket
tcp
udp
function
timestamp
Set message payload
Debug msg.payload

6. Execute: click on Inject button and check results in Debug pane

Start flow

Example: Hello LDAC Summer School!

7. Export flow



[{"id":"148e3965.53767f","type":"debug","z":"283e160d.c1304a","name":"Debug msg.payload","active":true,"tosidebar":true,"console":true,"tostatus":false,"complete":"payload","targetType":"msg","x":440,"y":200,"wires":[]},{"id":"478a9031.b808","type":"inject","z":"283e160d.c1304a","name":"","topic":"","payload":"","payloadType":"date","repeat":"","crontab":"","once":false,"onceDelay":0.1,"x":100,"y":80,"wires":[["112be1b8.535ec6"]]},{"id":"112be1b8.535ec6","type":"change","z":"283e160d.c1304a","name":"Set message payload","rules":[{"t":"set","p":"payload","pt":"msg","to":"Hello LDAC Summer School!","tot":"str"}],"action":"","property":"","from":"","to":"","reg":false,"x":260,"y":140,"wires":[["148e3965.53767f"]]}]

Alternative flow (2): inject part of the message

[{"id":"4855565d.e62278","type":"debug","z":"85679f4e.4e529","name":"Debug msg.payload","active":true,"tosidebar":true,"console":true,"tostatus":false,"complete":"payload","targetType":"msg","x":440,"y":200,"wires":[]},{"id":"67c10546.ab0594","type":"inject","z":"85679f4e.4e529","name":"Inject \"Hello \"","topic":"","payload":"Hello","payloadType":"str","repeat":"","crontab":"","once":false,"onceDelay":0.1,"x":110,"y":80,"wires":[["cea55947.537d68"]]},{"id":"cea55947.537d68","type":"change","z":"85679f4e.4e529","name":"Add \"LDAC Summer School\"","rules":[{"t":"set","p":"payload","pt":"msg","to":"payload & \" LDAC Summer School\"","tot":"jsonata"}],"action":"","property":"","from":"","to":"","reg":false,"x":240,"y":140,"wires":[["4855565d.e62278"]]}]

Alternative flow (3): use function node

Node-RED
Deploy
filter nodes
Hello LDAC (2)
Hello LDAC (3)
Flow 1
debug
websocket
tcp
udp
function
function
template
Inject "Hello"
Add "LDAC Summer School!"
Debug msg.payload
all nodes
16/6/2019, 13:59:17 node: Debug
msg.payload
msg.payload : string[26]
"Hello LDAC Summer School!"

[{"id":"1f21a9f.25f0f56","type":"debug","z":"810f777b.83fa2","name":"Debug msg.payload","active":true,"tosidebar":true,"console":true,"tostatus":false,"complete":"payload","targetType":"msg","x":440,"y":180,"wires":[]},{"id":"cc423328.2163a","type":"inject","z":"810f777b.83fa2","name":"Inject \"Hello\" ","topic":"","payload":"Hello ","payloadType":"str","repeat":"","crontab":"","once":false,"onceDelay":0.1,"x":110,"y":60,"wires":[["1ff89f23.5a8e11"]]},{"id":"1ff89f23.5a8e11","type":"function","z":"810f777b.83fa2","name":"Add \"LDAC Summer School!\"","func":"msg.payload += \" LDAC Summer School!\"\nreturn msg;","outputs":1,"noerr":0,"x":260,"y":120,"wires":[["1f21a9f.25f0f56"]]}]

Default nodes

input
- inject
- catch
- status
- link
- mqtt
- http
- websocket
- tcp
- udp

output
- debug
- link
- mqtt
- http response
- websocket
- tcp
- udp

function
- function
- template
- delay
- trigger
- comment
- http request
- tcp request
- switch
- change
- range
- split

function
- join
- sort
- batch
- csv
- html
- json
- xml
- yaml
- rbe
- http auth

social
- email
- twitter
- email
- twitter

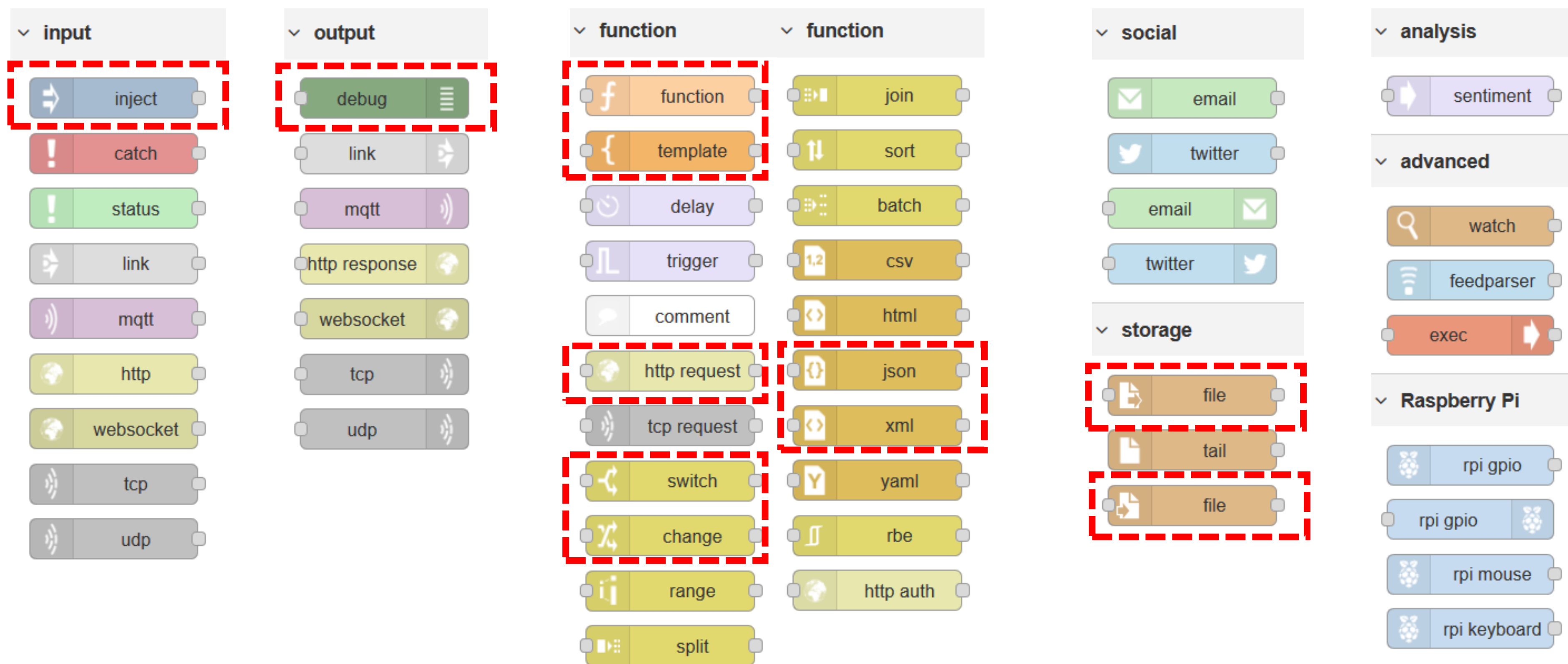
storage
- file
- tail
- file

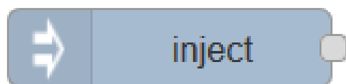
analysis
- sentiment

advanced
- watch
- feedparser
- exec

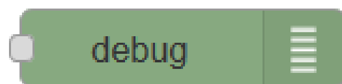
Raspberry Pi
- rpi gpio
- rpi gpio
- rpi mouse
- rpi keyboard

Relevant nodes





Injects a message into a flow either manually or at regular intervals. The message payload can be a variety of types, including strings, JavaScript objects or the current time.
The Inject node can initiate a flow with a specific payload value. The node also supports injecting timestamp , strings, numbers, booleans, JavaScript objects, or flow/global context values.
By default, the node is triggered manually by clicking on its button within the editor. It can also be set to inject at regular intervals or according to a schedule.



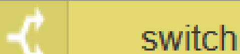
Displays selected message properties in the debug sidebar tab and optionally the runtime log. By default it displays **msg.payload**, but can be configured to display any property, the full message or the result of a **JSONata expression**.
The debug sidebar provides a structured view of the messages it is sent, making it easier to understand their structure.
JavaScript objects and arrays can be collapsed and expanded as required.
Alongside each message, the debug sidebar includes information about the time the message was received, the node that sent it and the type of the message.
The button on the node can be used to enable or disable its output.

A JavaScript function block to run against the messages being received by the node. The messages are passed in as a JavaScript object called **msg**. By convention it will have a **msg.payload** property containing the body of the message. The function is expected to return a message object (or multiple message objects), but can choose to return nothing in order to halt a flow.

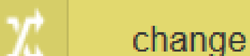
The Template node can be used to generate text using a message's properties to fill out a template. It uses the Mustache templating language to generate the result.
For example, a template of:

```
This is the payload: {{payload}} !
```

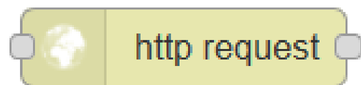
Will replace `{{payload}}` with the value of the message's payload property.



The Switch node allows messages to be routed to different branches of a flow by evaluating a set of rules against each message.The node is configured with the property to test - which can be either a message property or a context property.



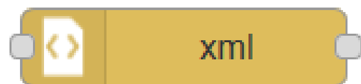
The Change node can be used to modify a message's properties and set context properties without having to resort to a Function node. Each node can be configured with multiple operations that are applied in order. The available operations are: Set, Change, Move, Delete



Sends HTTP requests and returns the response.
Key Inputs:
- url (string): url of the request.
- method (string): HTTP method of the request, i.e. one of GET, PUT, POST, PATCH or DELETE.
- headers (object): HTTP headers of the request.
- payload: body of the request

in output, payload contains the body of the response. The node can be configured to return the body as a string, attempt to parse it as a JSON string or leave it as a binary buffer.

Converts between a JSON string and its JavaScript object representation, in either direction.



Converts between an XML string and its JavaScript object representation, in either direction.

Reads the contents of a file as either a string or binary buffer.

Writes msg.payload to a file, either adding to the end or replacing the existing content. Alternatively, it can delete the file.

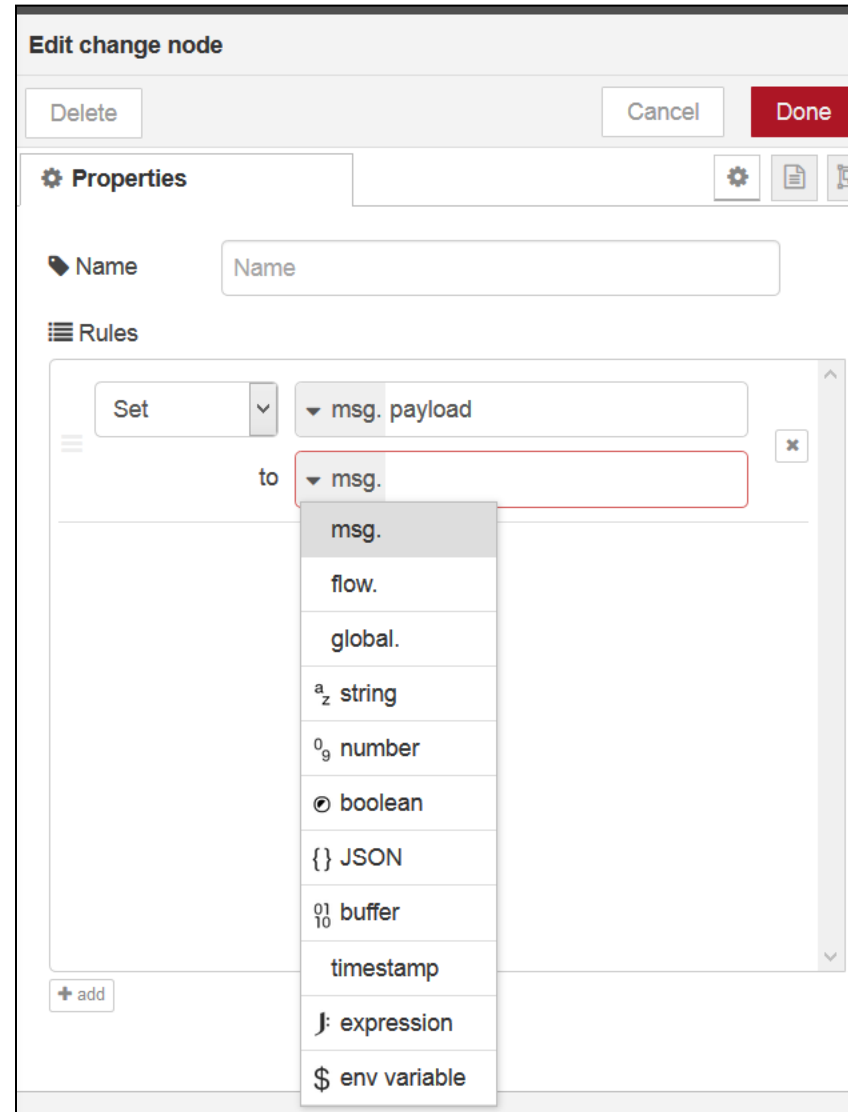
There are two main nodes for modifying a message, the Change node and the Function node.

The **Change node** provides a lot of functionality without needing to write JavaScript code. Not only can it modify message properties, but it can also access flow- and global-context.

The Change node provides four basic operations:

- **Set** a property to a value,
- **Change** a String property by performing a search and replace,
- **Delete** a property,
- **Move** a property.

More than one change can be assigned to one node. The resulting value can be hardcoded (e.g. string, number) or defined by elaborating another message.



JSONata expressions can be exploited to make complex elaborations based on input messages.

Edit change node
Delete Cancel Done
Properties
Name Name
Rules
Set msg. payload
to J: payload & " abc"

Edit change node
Delete Cancel Done
Properties
Name Name
Rules
Set msg. payload
to J: payload + 10

More information about JSONata can be found at http://jsonata.org/

JSONata

JSON query and transformation language

```
Address.City
FirstName & ' ' & Surname
Phone[type = 'mobile'].number
$sum(Order.Product.(Price * Quantity))
```

♪ Go play in the JSONata Exerciser ♪

The **Function node** allows you to run any **JavaScript** code against the message. This gives you complete flexibility in what you do with the message, but does require familiarity with JavaScript and is unnecessary for many simple cases.

In particular, you can use function node when there is no existing node dedicated to your task at hand.

```
var inputpayload = msg.payload; // get the message payload

msg.payload = newpayload; // modify the message payload

var newproperty;
msg.newproperty= newvalue; // the contents of the message can be enriched with properties

var msg1 ={ payload: msg.payload, topic:msg.topic}; // create a new message object
return msg1;
```

A function must return a message, otherwise the flow stops.

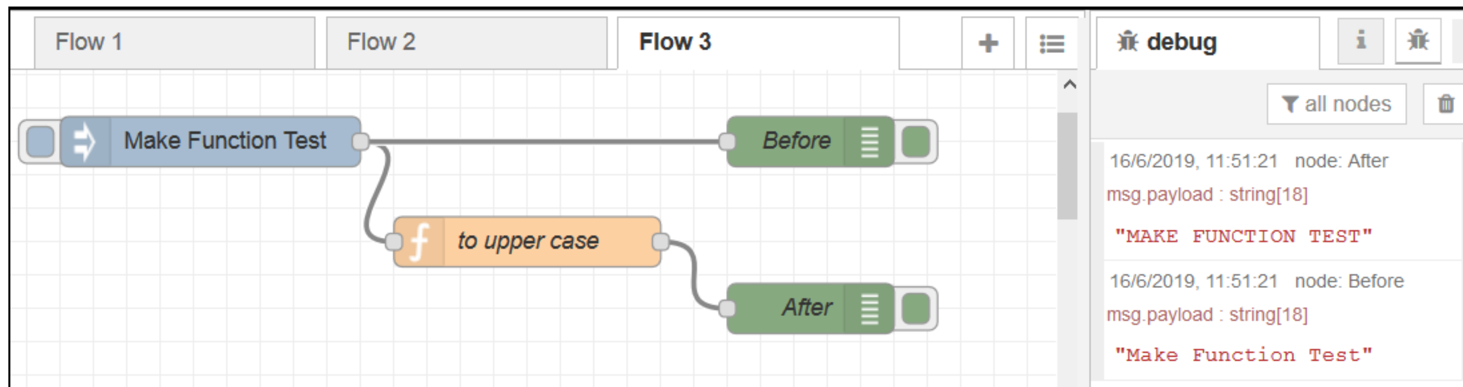
The **Function node** allows you to run any **JavaScript** code against the message. This gives you complete flexibility in what you do with the message, but does require familiarity with JavaScript and is unnecessary for many simple cases.

In particular, you can use function node when there is no existing node dedicated to your task at hand.

```
var inputpayload = msg.payload; // get the message payload

msg.payload = newpayload; // modify the message payload

var newproperty;
msg.newproperty= newvalue; // the contents of the message can be enriched with properties

var msg1 ={ payload: msg.payload, topic:msg.topic}; // create a new message object
return msg1;
```

A function must return a message, otherwise the flow stops.

Example



Function body:

```
msg.payload = msg.payload.toUpperCase()
return msg;
```

[{"id":"c6a5d62f.46d2f","type":"tab","label":"Flow 3","disabled":false,"info":""},{"id":"ec2f106.b8260f","type":"function","z":"c6a5d62f.46d2f","name":"to upper case","func":"msg.payload = msg.payload.toUpperCase()\nreturn msg;","outputs":1,"noerr":0,"x":320,"y":180,"wires":[["c011ed5d.75eda"]]},{"id":"cdefe980.e69b4","type":"inject","z":"c6a5d62f.46d2f","name":"","topic":"","payload":"Make Function Test","payloadType":"str","repeat":"","crontab":"","once":false,"onceDelay":0.1,"x":130,"y":120,"wires":[["ec2f106.b8260f","91e5aad8.61ea78"]]},{"id":"c011ed5d.75eda","type":"debug","z":"c6a5d62f.46d2f","name":"After","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"payload","targetType":"msg","x":490,"y":220,"wires":[]},{"id":"91e5aad8.61ea78","type":"debug","z":"c6a5d62f.46d2f","name":"Before","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"payload","targetType":"msg","x":490,"y":120,"wires":[]}]

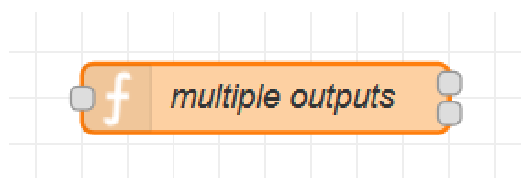
The function node can be configured with multiple outputs. This is useful when the flow splits into separate paths depending on a message property. To configure multiple outputs open the function node and use the up/down arrows to adjust the number of outputs.

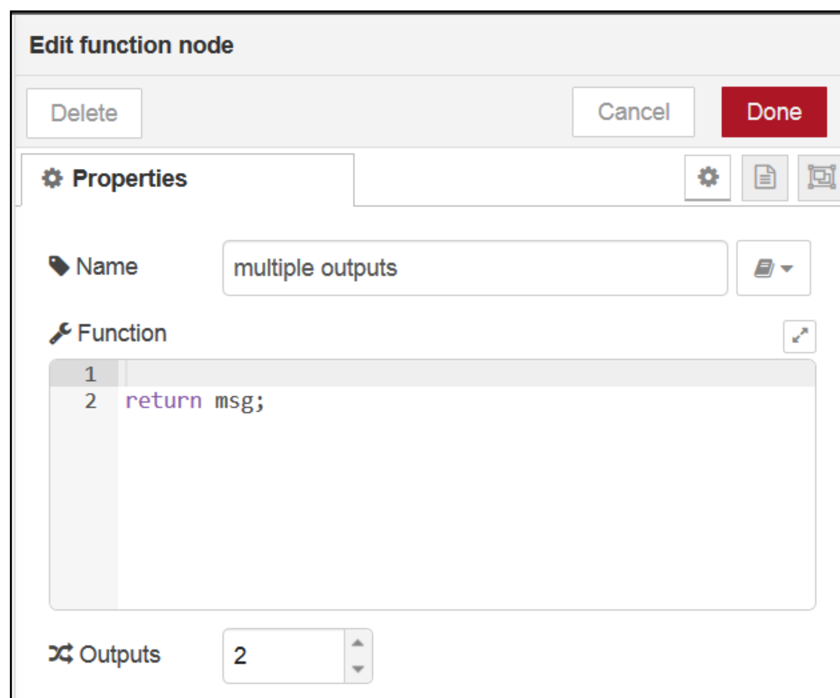
To return messages to multiple outputs you need to return an array, e.g.

```
return[msg1,msg2];
```

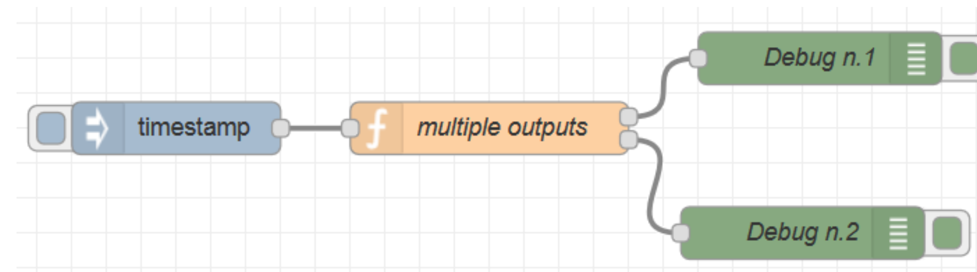
msg1 will appear on output1 and msg2 on output2. To stop a flow you return null, e.g.

```
return[msg1,null];
```



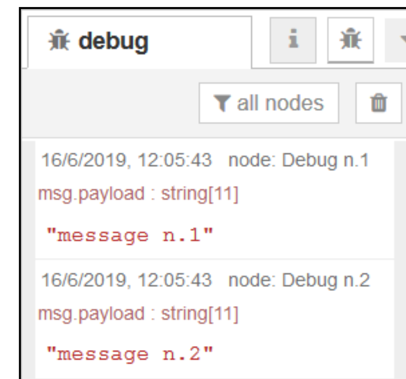


Multiple outputs example



Function body:

```
var msg1 = {payload: "",topic: ""}
msg1.payload = "message n.1 "
var msg2 = {payload: "",topic: ""}
msg2.payload = "message n.2"
return [msg1,msg2];
```



[{"id":"439af97a.44ef38","type":"tab","label":"Flow 4","disabled":false,"info":""},{"id":"dc28df5c.459198","type":"function","z":"439af97a.44ef38","name":"multiple outputs","func":"var msg1 = {payload: \"\",topic: \"\"}\nmsg1.payload = \"message n.1\"\nvar msg2 = {payload: \"\",topic: \"\"}\nmsg2.payload = \"message n.2\"\n\nreturn [msg1,msg2];","outputs":2,"noerr":0,"x":280,"y":80,"wires":[["31f9f142.ac463e"],["1af074e3.f0c223"]]},{"id":"8dc40387.f59c88","type":"inject","z":"439af97a.44ef38","name":"","topic":"","payload":"","payloadType":"date","repeat":"","crontab":"","once":false,"onceDelay":0.1,"x":100,"y":80,"wires":[["dc28df5c.459198"]]},{"id":"31f9f142.ac463e","type":"debug","z":"439af97a.44ef38","name":"Debug n.1","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"payload","targetType":"msg","x":470,"y":40,"wires":[]},{"id":"1af074e3.f0c223","type":"debug","z":"439af97a.44ef38","name":"Debug n.2","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"payload","targetType":"msg","x":460,"y":140,"wires":[]}]

Multiple outputs in array

timestamp
multiple outputs in array
Debug

all nodes

16/6/2019, 12:13:35 node: Debug
msg : Object
{ payload: "message n.1", topic: "", _msgid: "b901c07f.7e797" }

16/6/2019, 12:13:35 node: Debug
msg : Object
{ payload: "message n.2", topic: "", _msgid: "b901c07f.7e797" }

Function body:

```
var msg1 = {payload: "",topic: ""}
msg1.payload = "message n.1"
var msg2 = {payload: "",topic: ""}
msg2.payload = "message n.2"
var allmsg = []
allmsg.push(msg1)
allmsg.push(msg2)
return [allmsg];
```

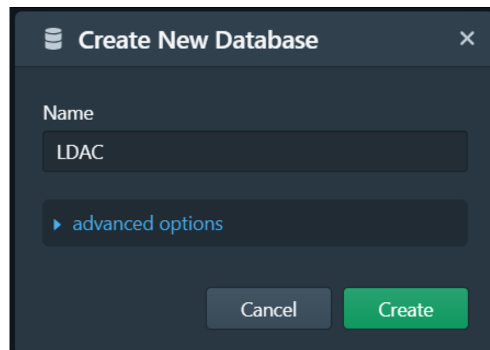
[{"id":"439af97a.44ef38","type":"tab","label":"Flow 4","disabled":false,"info":""},{"id":"dc28df5c.459198","type":"function","z":"439af97a.44ef38","name":"multiple outputs in array","func":"var msg1 = {payload: \"\",topic: \"\"}\nmsg1.payload = \"message n.1\"\nvar msg2 = {payload: \"\",topic: \"\"}\nmsg2.payload = \"message n.2\"\n\nvar allmsg = []\nallmsg.push(msg1)\nallmsg.push(msg2)\nreturn [allmsg];","outputs":1,"noerr":0,"x":290,"y":120,"wires":[["31f9f142.ac463e"]]},{"id":"8dc40387.f59c88","type":"inject","z":"439af97a.44ef38","name":"","topic":"","payload":"","payloadType":"date","repeat":"","crontab":"","once":false,"onceDelay":0.1,"x":100,"y":80,"wires":[["dc28df5c.459198"]]},{"id":"31f9f142.ac463e","type":"debug","z":"439af97a.44ef38","name":"Debug","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"true","targetType":"full","x":490,"y":160,"wires":[]}]

Node-RED can be employed to create flows involving the query and update of triple stores (RDF stores) while integrating other functionalities.
Herein we show how basic nodes can be used to make SPARQL queries/updates while accessing an RDF Store.

SETUP

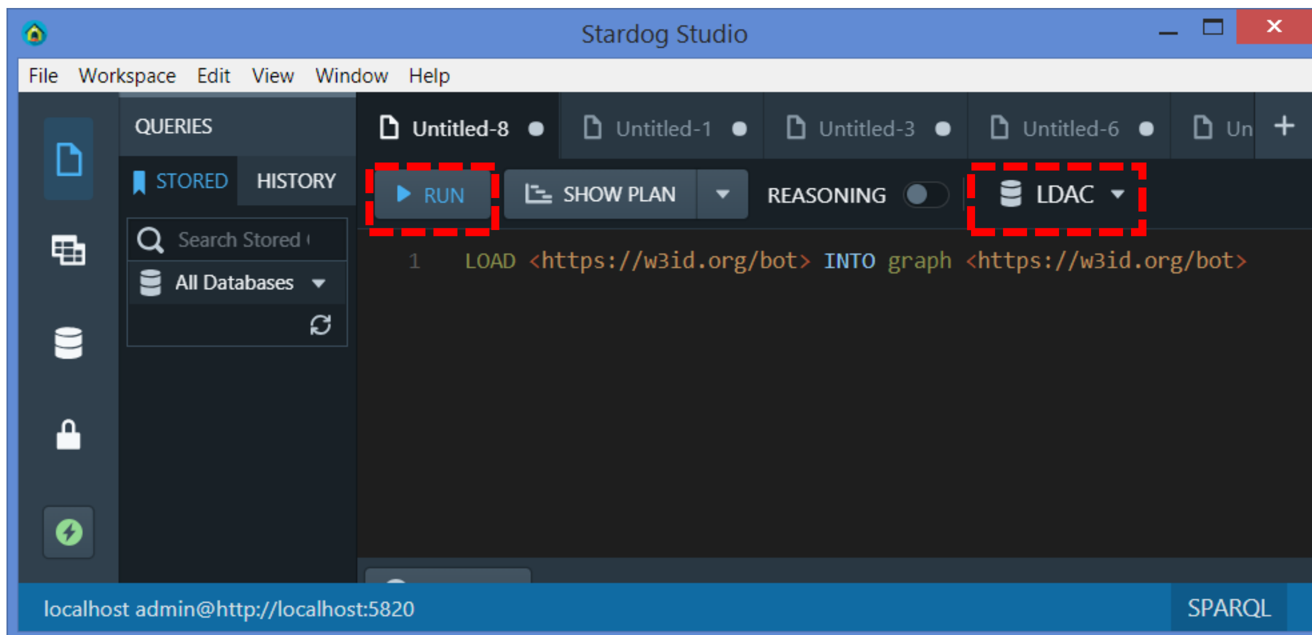
- Stardog is employed as triple store
- The examples refers to a Stardog installation available in localhost
- The examples are based on the BOT ontology (https://github.com/w3c-lbd-cg/bot) that must loaded on Stardog database "LDAC"

Create LDAC database in Stardog Studio



Load BOT ontology by running this query in Stardog Studio:

```
LOAD <https://w3id.org/bot> INTO graph <https://w3id.org/bot>
```



SPARQL query settings (1)

Setting to execute a SPARQL Query (in Stardog) via HTTP request

URL (server, DB, request)
http://localhost:5820/LDAC/query

Headers
```
content-type = application/x-www-form-urlencoded
Accept = application/sparql-results+json
```

SPARQL query (1)

Get all classes defined in BOT ontology

```
select distinct ?botclass
FROM <https://w3id.org/bot>
where {
      ?botclass rdf:type owl:Class .
}
```

Default Inject node

Node-RED
Deploy
Query
Update
Query
make request
Set URL & Headers
SPARQL query
http request
Edit inject node
Delete
Cancel
Done
Properties
Payload
timestamp
Topic
Inject once after 0.1 seconds, then
Repeat
none
Name
make request
Note: "interval between times" and "at a specific time" will use cron. "interval" should be less than 596 hours. See info box for details.

Set URL and Headers using **Change node**

Node-RED

Deploy

Query | Update

make request

Set URL & Headers

http request

Edit change node

Delete | Cancel | Done

Properties

Name: Set URL & Headers

Rules

Set	msg.	url
to		http://localhost:5820/LDAC/query
Set	msg.	headers['content-type']
to		application/x-www-form-urlencoded
Set	msg.	headers['Accept']
to		application/sparql-results+json

add

Define SPARQL query as **payload** using **Template node**.

Finalize the query by adding the text "query=" in front of it.
A Change node can be used together with a JSONata expression.
Other options: use a Function node; include the missing text in the previous node (Template)

SPARQL query (1)

Make a HTTP request with the **http request node.** Method POST is selected.
Use authentication (unless Stardog is started w/o security) and specify user and password (default in Stardog: admin, admin). Specify that a JSON object is returned as results.
URL is already received as msg.url.

Node-RED
Deploy
Query
Update
Query
Edit http request node
Delete
Cancel
Done
Properties
uest
URL & Headers
SPARQL query
finalize query
Method POST
URL http://
Enable secure (SSL/TLS) connection
Use authentication
Type basic authentication
Username admin
Password ••••••••
Use proxy
Return a parsed JSON object
Name Name
Bindings
http request
URIs

Node-RED

SPARQL query (1)

Show the full output in the **payload** using a **Debug node**.

Extract only the URIs of the result using a JSONata in a **Debug node**.

Node-RED
Deploy
Query
Update
Edit debug node
Delete
Cancel
Done
Properties
SPARQL query
finalize query
Output
payload.results.bindings.botclass.value
To
debug window
system console
node status (32 characters)
Bindings
http request
URIs
Name
URIs

Query results:

```
array[9]
0: "http://purl.org/vocommons/voaf#Vocabulary"
1: "http://xmlns.com/foaf/0.1/Person"
2: "https://w3id.org/bot#Zone"
3: "https://w3id.org/bot#Element"
4: "https://w3id.org/bot#Interface"
5: "https://w3id.org/bot#Site"
6: "https://w3id.org/bot#Building"
7: "https://w3id.org/bot#Storey"
8: "https://w3id.org/bot#Space"
```

SPARQL query (1)

Exported flow

[{"id":"383e0c8c.5a7d0c","type":"inject","z":"f0f1a3db.d85df","name":"make
request","topic":"","payload":"","payloadType":"date","repeat":"","crontab":"","once":false,"onceDelay":"","x":170,"y"
:140,"wires":[["bb2f0eb2.b3e71"]]},{"id":"6a30fe9c.c16a78","type":"template","z":"f0f1a3db.d85df","name":"SPARQL
query","field":"payload","fieldType":"msg","format":"text","syntax":"plain","template":"select distinct ?botclass
\nFROM <https://w3id.org/bot>\nwhere { \n   ?botclass rdf:type owl:Class .
\n}","output":"str","x":440,"y":220,"wires":[["5390e2c7.0b9c2c"]]},{"id":"a50bda43.26d36","type":"http
request","z":"f0f1a3db.d85df","name":"","method":"POST","ret":"obj","paytoqs":false,"url":"","tls":"","proxy":"","auth
Type":"basic","x":370,"y":340,"wires":[["bf6562c1.d99d58","54b7c078.dcf43"]]},{"id":"bf6562c1.d99d58","type":"debu
g","z":"f0f1a3db.d85df","name":"Bindings","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"
payload","targetType":"msg","x":620,"y":320,"wires":[]},{"id":"bb2f0eb2.b3e71","type":"change","z":"f0f1a3db.d85df",
"name":"Set URL &
Headers","rules":[{"t":"set","p":"url","pt":"msg","to":"http://localhost:5820/LDAC/query","tot":"str"},{"t":"set","p":"he
aders['content-type']","pt":"msg","to":"application/x-www-form-
urlencoded","tot":"str"},{"t":"set","p":"headers['Accept']","pt":"msg","to":"application/sparql-
results+json","tot":"str"}],"action":"","property":"","from":"","to":"","reg":false,"x":230,"y":220,"wires":[["6a30fe9c.c16
a78"]]},{"id":"54b7c078.dcf43","type":"debug","z":"f0f1a3db.d85df","name":"URIs","active":true,"tosidebar":true,"con
sole":false,"tostatus":false,"complete":"payload.results.bindings.botclass.value","targetType":"jsonata","x":610,"y":360
,"wires":[]},{"id":"5390e2c7.0b9c2c","type":"change","z":"f0f1a3db.d85df","name":"finalize
query","rules":[{"t":"set","p":"payload","pt":"msg","to":"\"query=\" &
payload","tot":"jsonata"}],"action":"","property":"","from":"","to":"","reg":false,"x":630,"y":220,"wires":[["a50bda43.2
6d36"]]}]

SPARQL update settings (2)

Setting to execute a SPARQL Update (in Stardog) via HTTP request

URL (server, DB, request)

`http://localhost:5820/LDAC/update`

Headers

`content-type = application/x-www-form-urlencoded`

SPARQL update (2)

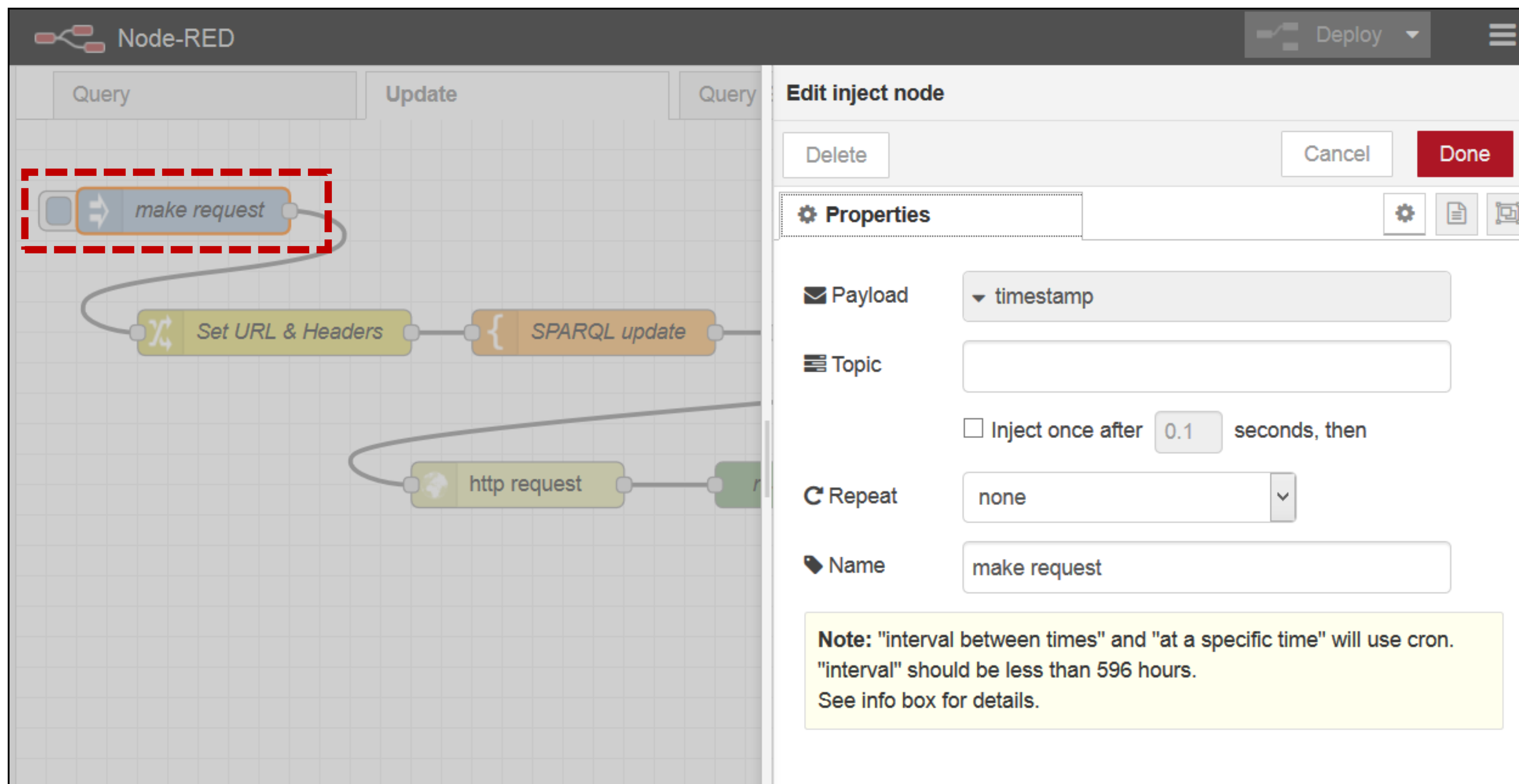
Add an individual of class bot:Zone in a new graph that imports BOT ontology

```
PREFIX bot: https://w3id.org/bot#
PREFIX ex: https://www.example.com#
INSERT DATA {
  GRAPH <https://www.example.com>  {
    <https://www.example.com> owl:imports <https://w3id.org/bot> .
    ex:NewZone rdf:type owl:NamedIndividual , bot:Zone.
}}
```

Node-RED
Deploy
Query
Update
Query Sequence
debug
all nodes
make request
Set URL & Headers
SPARQL update
finalize query
http request
statusCode
17/6/2019, 00:11:56 node: statusCode
msg.statusCode : number
200

SPARQL update (2)

Default Inject node



Set URL and Headers using **Change node**

Node-RED
Deploy
Query
Update
make request
Set URL & Headers
SPARQL update
http request
Edit change node
Delete
Cancel
Done
Properties
Name: Set URL & Headers
Rules
Set msg. url
to http://localhost:5820/LDAC/update
Set msg. headers['content-type']
to application/x-www-form-urlencoded

SPARQL update (2)

Define SPARQL update as **payload** using **Template node**.

Node-RED

Deploy

filter nodes

Query

Upda

input

inject

catch

status

link

mqtt

http

websocket

tcp

udp

output

debug

SPARQL update

http request

Edit template node

Delete

Cancel

Done

Properties

Name: SPARQL update

Property: msg. payload

Format: Plain text

Template

Syntax Highlight: none

```
1  PREFIX bot: <https://w3id.org/bot#>
2  PREFIX ex: <https://www.example.com#>
3
4  INSERT DATA {
5    GRAPH <https://www.example.com>  {
6      <https://www.example.com> owl:imports <https://w3id.org/bot> .
7      ex:NewZone rdf:type owl:NamedIndividual , bot:Zone.
8    }
9  }
10
```

Output as: Plain text

SPARQL update (2)

Finalize the update by adding the text "query=" in front of it.
A Change node can be used together with a JSONata expression.
Other options: use a Function node; include the missing text in the previous node (Template)

SPARQL update (2)

Make a HTTP request with the **http request node.** Method POST is selected.
Use authentication (unless Stardog is started w/o security) and specify user and password (default in Stardog: admin, admin). URL is already received as msg.url.

Node-RED
Deploy
Query
Update
Query
SPARQL update
finalize query
http request
statusCode
Edit http request node
Delete
Cancel
Done
Properties
Method POST
URL http://
Enable secure (SSL/TLS) connection
Use authentication
Type basic authentication
Username admin
Password ••••••••
Use proxy
Return a UTF-8 string

SPARQL update (2)

The http request returns the status code that is shown in **msg.statusCode** using a **Debug node**. Code 200 means the request was successful.

SPARQL update (2)

Update results:

```
msg.statusCode : number
200
```

Exported flow


```
[{"id":"8e217d16.03ffc8","type":"inject","z":"7b9ab328.92ad0c","name":"make
request","topic":"","payload":"","payloadType":"date","repeat":"","crontab":"","once":false,"onceDelay":"","x":110,"y":60,"wire
s":[["e37b680d.98a458"]]},{"id":"389a0ae7.cfc906","type":"template","z":"7b9ab328.92ad0c","name":"SPARQL
update","field":"payload","fieldType":"msg","format":"text","syntax":"plain","template":"PREFIX bot:
<https://w3id.org/bot#>\nPREFIX ex: <https://www.example.com#>\n\nINSERT DATA { \n  GRAPH <https://www.example.com>
{\n    <https://www.example.com> owl:imports <https://w3id.org/bot> .\n  \tex:NewZone rdf:type owl:NamedIndividual ,
bot:Zone.\n  }\n}\n","output":"str","x":380,"y":140,"wires":[["482eb33b.cadd8c"]]},{"id":"6c88eba5.82a624","type":"http
request","z":"7b9ab328.92ad0c","name":"","method":"POST","ret":"txt","paytoqs":false,"url":"","tls":"","proxy":"","authType":"
basic","x":330,"y":240,"wires":[["745b9c05.eba1c4"]]},{"id":"745b9c05.eba1c4","type":"debug","z":"7b9ab328.92ad0c","name"
:"statusCode","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"statusCode","targetType":"msg","x":53
0,"y":240,"wires":[]},{"id":"e37b680d.98a458","type":"change","z":"7b9ab328.92ad0c","name":"Set URL &
Headers","rules":[{"t":"set","p":"url","pt":"msg","to":"http://localhost:5820/LDAC/update","tot":"str"},{"t":"set","p":"headers['c
ontent-type']","pt":"msg","to":"application/x-www-form-
urlencoded","tot":"str"}],"action":"","property":"","from":"","to":"","reg":false,"x":170,"y":140,"wires":[["389a0ae7.cfc906"]]},{"
id":"482eb33b.cadd8c","type":"change","z":"7b9ab328.92ad0c","name":"finalize
query","rules":[{"t":"set","p":"payload","pt":"msg","to":"\"query=\" &
payload","tot":"jsonata"}],"action":"","property":"","from":"","to":"","reg":false,"x":570,"y":140,"wires":[["6c88eba5.82a624"]]}
]
```

Sequential SPARQL queries (3)

Get all classes defined in BOT ontology . Then for each class get the properties where that class is the domain.

The proposed solution splits the results of the first query, thus creating a set of sequential messages that are used to configure the second query. Therefore the second query can be executed several times.

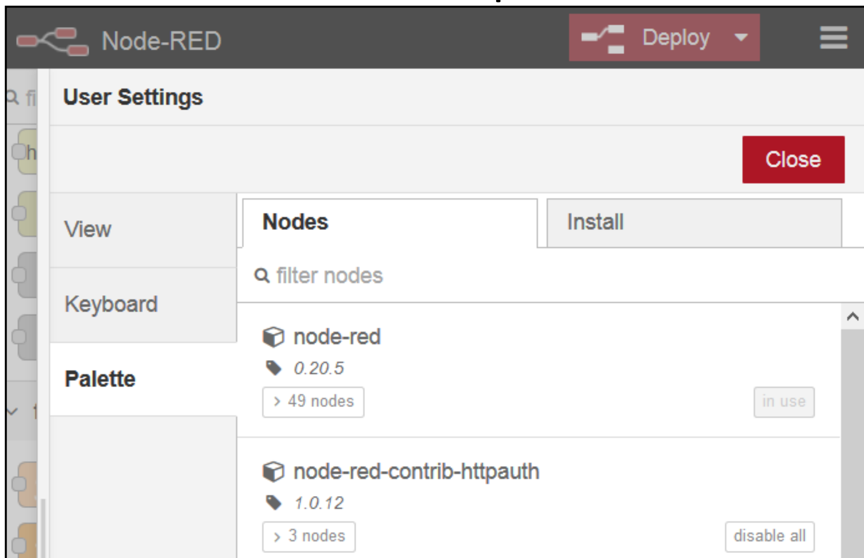
Exported flow

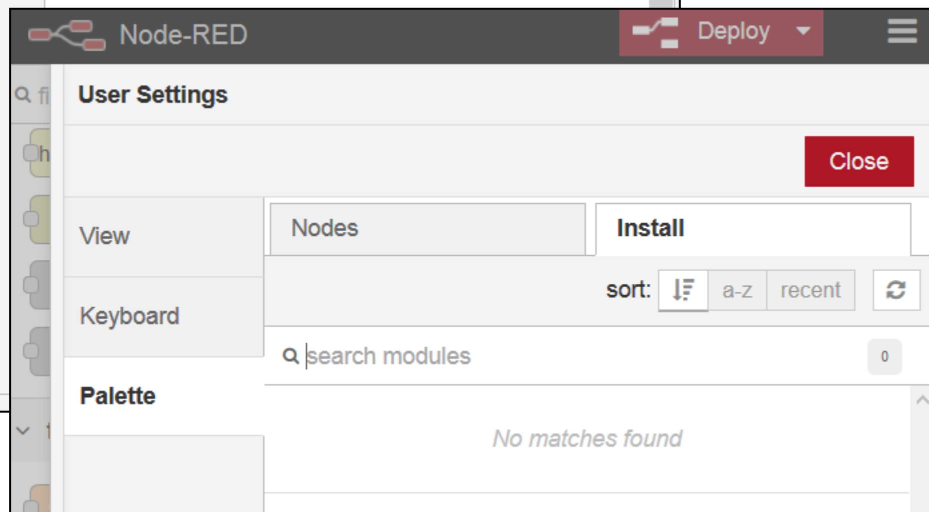

```
[{"id":"59bfaf1b.8937e","type":"tab","label":"Query
Sequence","disabled":false,"info":""},{"id":"b8f665a5.a6725","type":"inject","z":"59bfaf1b.8937e","name":"make
request","topic":"","payload":"","payloadType":"date","repeat":"","crontab":"","once":false,"onceDelay":"","x":130,"y":40,"wires":[["845281d5.018cf"]]},{
"id":"59d3a3ee.95f184","type":"template","z":"59bfaf1b.8937e","name":"SPARQL
query","field":"payload","fieldType":"msg","format":"text","syntax":"plain","template":"query=\nselect distinct ?botclass \nFROM
<https://w3id.org/bot>\nwhere { \n    ?botclass rdf:type owl:Class .
\n}","output":"str","x":420,"y":140,"wires":[["8248d7b0.962c08"]]},{"id":"8248d7b0.962c08","type":"http
request","z":"59bfaf1b.8937e","name":"","method":"POST","ret":"obj","paytoqs":false,"url":"","tls":"","proxy":"","authType":"basic","x":610,"y":140,"wir
es":[["c6e99b04.3067c","90c2c2e6.1e2ae"]]},{"id":"845281d5.018cf","type":"change","z":"59bfaf1b.8937e","name":"Set URL &
Headers","rules":[{"t":"set","p":"url","pt":"msg","to":"http://localhost:5820/LDAC/query","tot":"str"},{"t":"set","p":"headers['content-
type']","pt":"msg","to":"application/x-www-form-urlencoded","tot":"str"},{"t":"set","p":"headers['Accept']","pt":"msg","to":"application/sparql-
results+json","tot":"str"}],"action":"","property":"","from":"","to":"","reg":false,"x":190,"y":140,"wires":[["59d3a3ee.95f184"]]},{"id":"c6e99b04.3067c","t
ype":"debug","z":"59bfaf1b.8937e","name":"URIs","active":false,"tosidebar":true,"console":false,"tostatus":false,"complete":"payload.results.bindings.bo
tclass.value","targetType":"jsonata","x":810,"y":140,"wires":[]},{"id":"9f1ce207.58f23","type":"split","z":"59bfaf1b.8937e","name":"","splt":"\\n","spltTyp
e":"str","arraySplt":1,"arraySpltType":"len","stream":false,"addname":"","x":470,"y":260,"wires":[["585fc625.2b85b"]]},{"id":"90c2c2e6.1e2ae","type":"ch
ange","z":"59bfaf1b.8937e","name":"Move results to
payload","rules":[{"t":"set","p":"payload","pt":"msg","to":"payload.results.bindings.botclass.value","tot":"jsonata"}],"action":"","property":"","from":"","to
":"","reg":false,"x":250,"y":260,"wires":[["9f1ce207.58f23"]]},{"id":"eef48833.0ad108","type":"debug","z":"59bfaf1b.8937e","name":"Results","active":tru
e,"tosidebar":true,"console":false,"tostatus":false,"complete":"payload.results.bindings","targetType":"jsonata","x":800,"y":380,"wires":[]},{"id":"73ff640
4.25f12c","type":"template","z":"59bfaf1b.8937e","name":"SPARQL
query","field":"payload","fieldType":"msg","format":"handlebars","syntax":"mustache","template":"query=\nselect distinct ?botclass ?prop \nFROM
<https://w3id.org/bot>\nwhere { \n    VALUES ?botclass {<{{{uri}}}>} \n    ?prop rdfs:domain ?botclass
.\n}","output":"str","x":420,"y":380,"wires":[["f488988f.d24918"]]},{"id":"f488988f.d24918","type":"http
request","z":"59bfaf1b.8937e","name":"","method":"POST","ret":"obj","paytoqs":false,"url":"","tls":"","proxy":"","authType":"basic","x":610,"y":380,"wir
es":[["eef48833.0ad108"]]},{"id":"ecca5a34.e79b4","type":"change","z":"59bfaf1b.8937e","name":"Set URL &
Headers","rules":[{"t":"set","p":"url","pt":"msg","to":"http://localhost:5820/LDAC/query","tot":"str"},{"t":"set","p":"headers['content-
type']","pt":"msg","to":"application/x-www-form-urlencoded","tot":"str"},{"t":"set","p":"headers['Accept']","pt":"msg","to":"application/sparql-
results+json","tot":"str"}],"action":"","property":"","from":"","to":"","reg":false,"x":210,"y":380,"wires":[["73ff6404.25f12c"]]},{"id":"585fc625.2b85b","ty
pe":"change","z":"59bfaf1b.8937e","name":"","rules":[{"t":"set","p":"uri","pt":"msg","to":"payload","tot":"msg"}],"action":"","property":"","from":"","to":
"","reg":false,"x":650,"y":260,"wires":[["ecca5a34.e79b4"]]}]
```

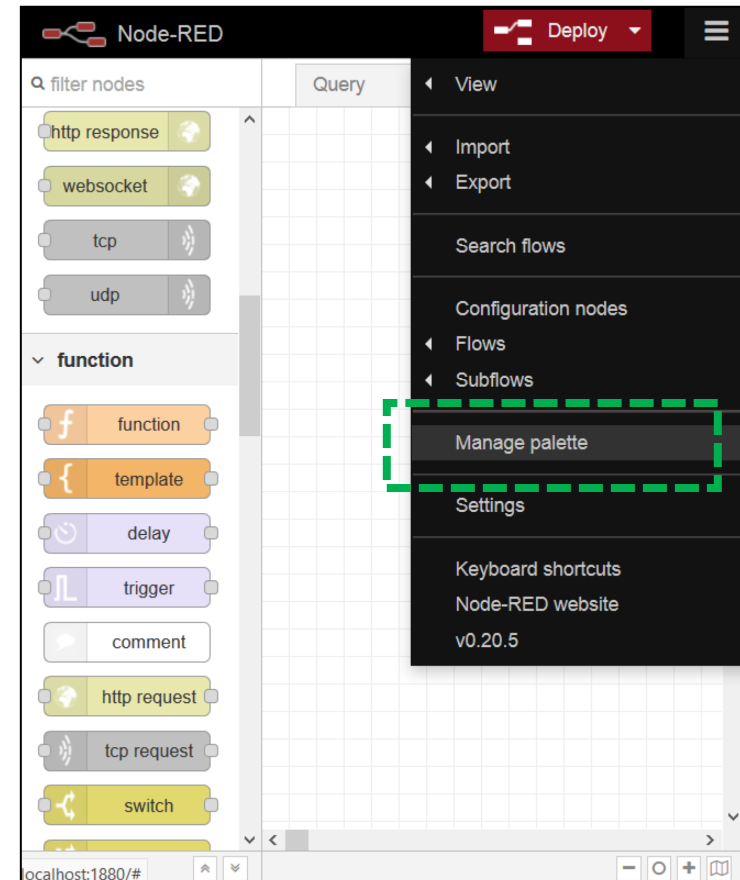
Further exercises

- implement SPARQL queries as seen during previous lectures of the LDAC Summer School
- repeat the SPARQL query/update using another triple store, e.g. GraphDB by Ontotext (http://graphdb.ontotext.com/documentation/standard/sparql-compliance.html). Other options are listed in the lecture about triple stores. Possibly only URL and headers must be updated.
- Make a flow that integrates a SPARQL query and a SPARQL update
- Make (complex) elaborations to generate a SPARQL query
- Make (complex) elaborations to consume the results of a SPARQL query
- Integrate SPARQL query/update with other data sources and IoT technologies, e.g.
  - Input/Output files
  - MQTT connection (e.g. in a sensor network)
  - UDP connection
  - A HTTP end-point (different from SPARQL end-point)
  - Other HTTP requests

- New nodes can be installed using the Palette Manager
- Browse and install published nodes.







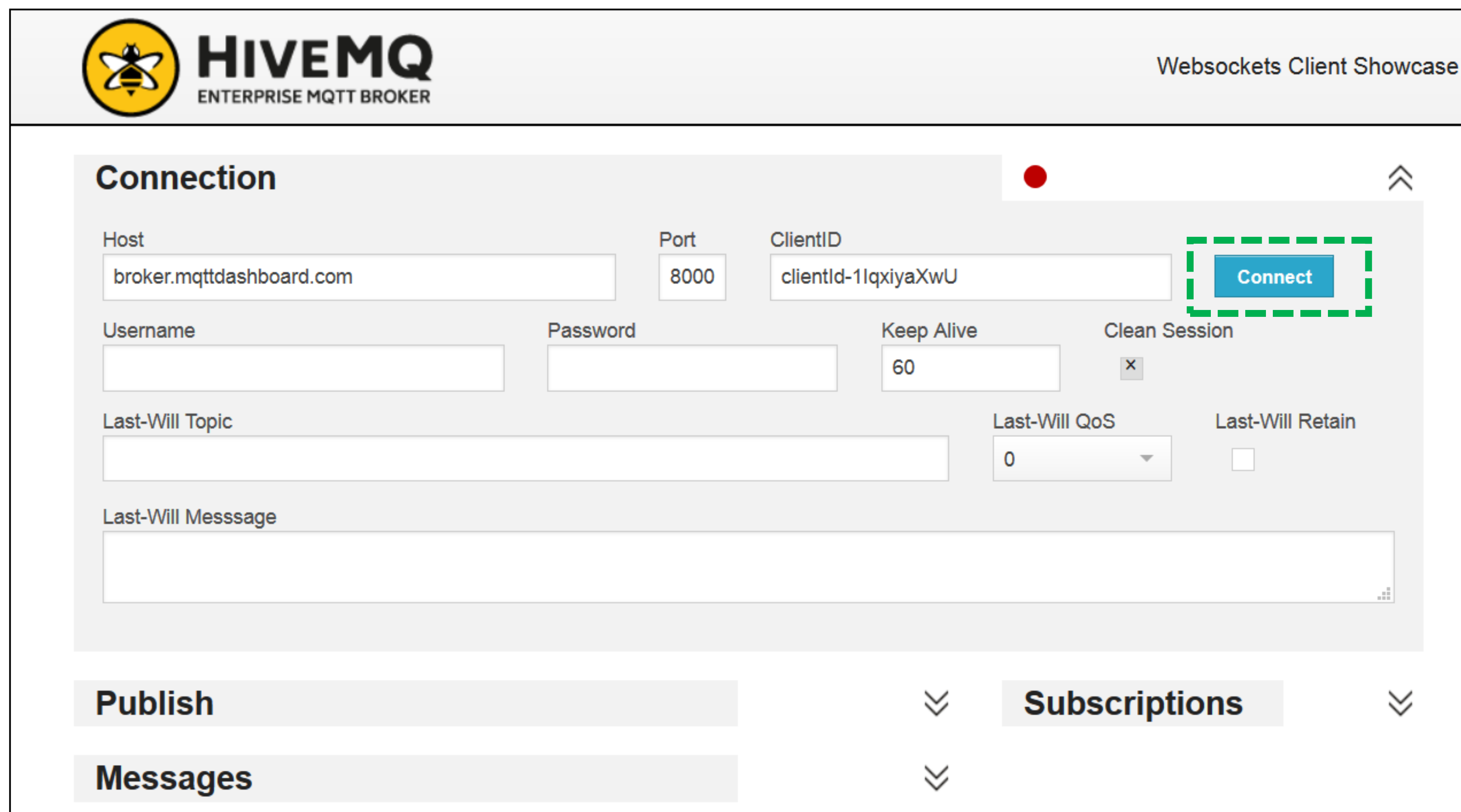
Another way of adding new nodes is via npm. Refer to Node-RED manual.

Connect to a MQTT broker and subscribe to messages from a specified topic.

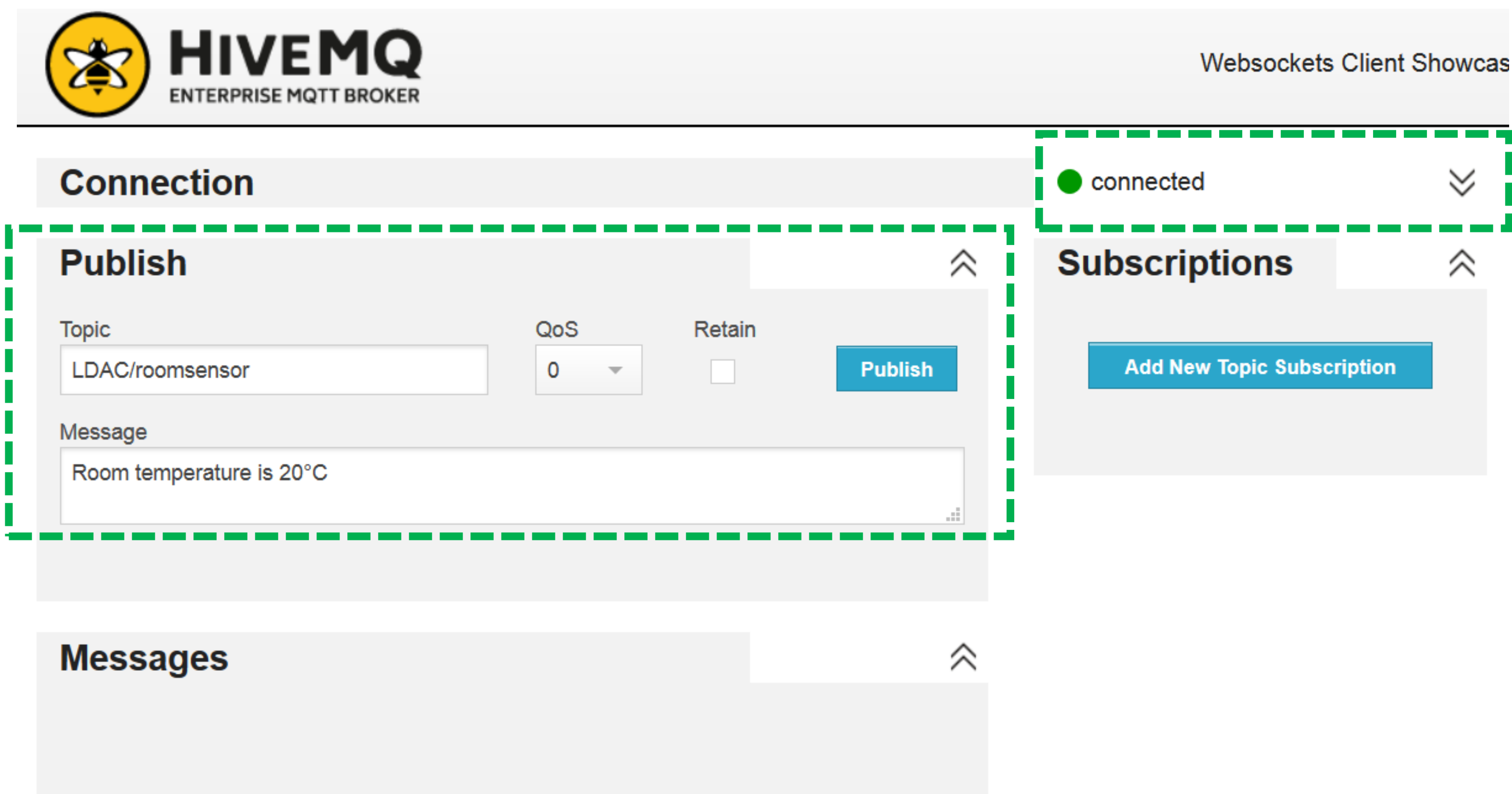
Use free online demo broker provided by HiveMQ

http://www.hivemq.com/demos/websocket-client/

Click on **Connect** button.



Configure Publish section



In Node-RED create a new flow and add an MQTT input node.
Set the server connection and topic (LDAC/roomsensor).

MQTT subscribe (4)

Add a Debug node and Deploy.

Publish the message in HiveMQ by clicking on the “Publish” button.

The subscription made in Node-RED receives the message and goes through Debug.

Node-RED
Deploy
filter nodes
input
inject
catch
status
link
w 7
Flow 8
MQTT subscribe
LDAC/roomsensor
connected
msg.payload
debug
all nodes
17/6/2019, 18:06:11 node: 5aad1055.c00fe8
LDAC/roomsensor : msg.payload : string[24]
"Room temperature is 20°C"

[{"id":"355547da.7ad858","type":"tab","label":"MQTT subscribe","disabled":false,"info":""},{"id":"27f1b8cf.b11c2","type":"mqtt in","z":"355547da.7ad858","name":"","topic":"LDAC/roomsensor","qos":"2","datatype":"auto","broker":"9b10bbd9.0639e8","x":230,"y":120,"wires":[["5aad1055.c00fe8"]]},{"id":"5aad1055.c00fe8","type":"debug","z":"355547da.7ad858","name":"","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"false","x":470,"y":120,"wires":[]},{"id":"9b10bbd9.0639e8","type":"mqtt-broker","z":"","name":"","broker":"broker.mqttdashboard.com","port":"1883","clientid":"","usetls":false,"compatmode":true,"keepalive":"15","cleansession":true,"birthTopic":"","birthQos":"0","birthPayload":"","closeTopic":"","closePayload":"","willTopic":"","willQos":"0","willPayload":""}]

If the message is structured as a JSON, then further elaborations are possible

[{"id":"b4daf526.ebf55","type":"tab","label":"MQTT subscribe JSON","disabled":false,"info":""},{"id":"46639621.cd2db8","type":"mqtt in","z":"b4daf526.ebf55","name":"","topic":"LDAC/roomsensor","qos":"2","datatype":"auto","broker":"9b10bbd9.0639e8","x":110,"y":140,"wires":[["f689ede5.af7ae8"]]},{"id":"2d989f3c.0ea25","type":"debug","z":"b4daf526.ebf55","name":"","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"false","x":350,"y":260,"wires":[]},{"id":"f689ede5.af7ae8","type":"json","z":"b4daf526.ebf55","name":"","property":"payload","action":"","pretty":false,"x":240,"y":200,"wires":[["2d989f3c.0ea25"]]},{"id":"9b10bbd9.0639e8","type":"mqtt-broker","z":"","name":"","broker":"broker.mqttdashboard.com","port":"1883","clientid":"","usetls":false,"compatmode":true,"keepalive":"15","cleansession":true,"birthTopic":"","birthQos":"0","birthPayload":"","closeTopic":"","closePayload":"","willTopic":"","willQos":"0","willPayload":""}]

MQTT publish (6)

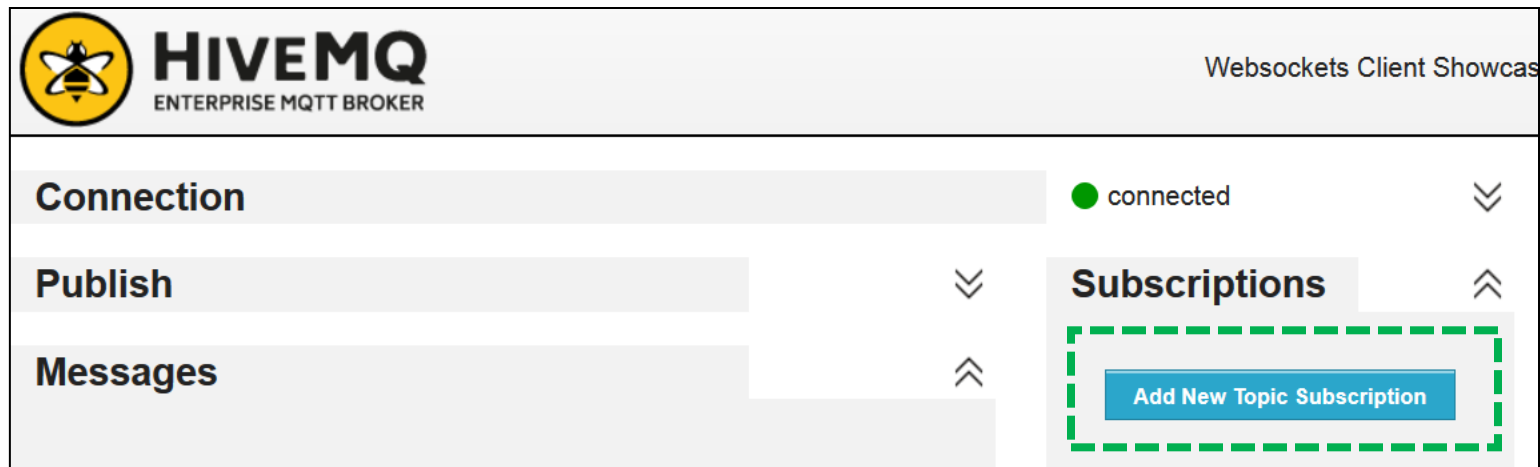
Connects to a MQTT broker and publishes messages.

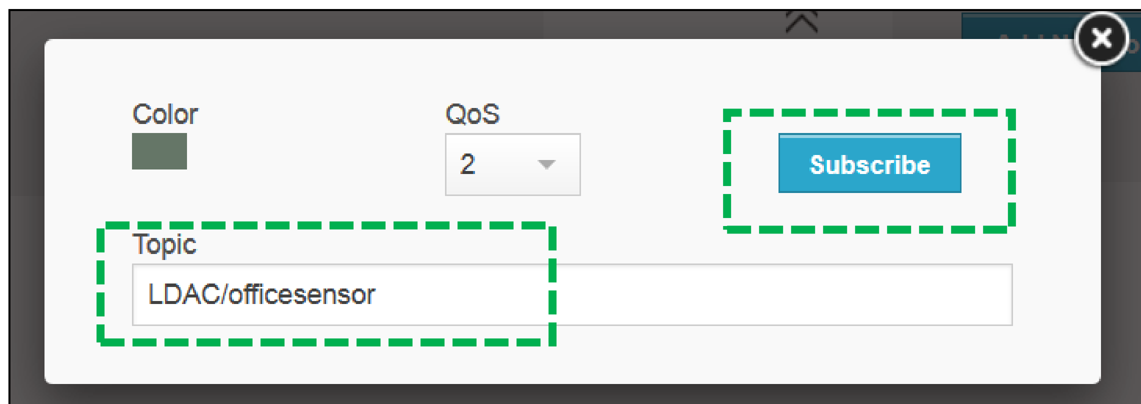
In Node-RED create a new flow and add an **MQTT output node**.

Set the server connection and topic (LDAC/officesensor).

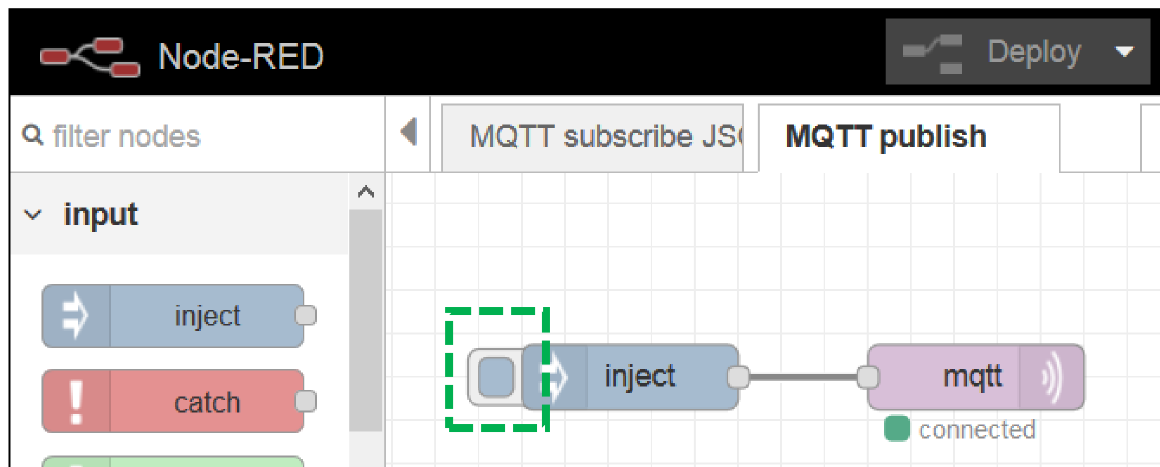
Add an Inject node that generates the message as JSON.

In HiveMQ add a New Topic Subscription





In Node-RED click on Inject button and the message will be received in HiveMQ



HIVEMQ
ENTERPRISE MQTT BROKER
Websockets Client Showcas

Connection — connected

Publish

Subscriptions

Messages

2019-06-17 18:34:19 Topic: LDAC/officesensor Qos: 0
{"sensor":"temperature","value":18}

Add New Topic Subscription

Qos: 2
LDAC/officesensor

MQTT publish (6)

[{"id":"88732d77.c66628","type":"tab","label":"MQTT publish","disabled":false,"info":""},{"id":"92745b13.80ea8","type":"mqtt out","z":"88732d77.c66628","name":"","topic":"","qos":"","retain":"","broker":"ee3aa3bc.8ac2f","x":530,"y":280,"wires":[]},{"id":"9991b19.87de85","type":"inject","z":"88732d77.c66628","name":"","topic":"LDAC/officesensor","payload":"{\"sensor\": \"temperature\", \"value\": 18}","payloadType":"json","repeat":"","crontab":"","once":false,"onceDelay":0.1,"x":370,"y":280,"wires":[["92745b13.80ea8"]]},{"id":"ee3aa3bc.8ac2f","type":"mqtt-broker","z":"","name":"","broker":"broker.mqttdashboard.com","port":"1883","clientid":"","usetls":false,"compatmode":true,"keepalive":"60","cleansession":true,"birthTopic":"","birthQos":"0","birthPayload":"","closeTopic":"","closePayload":"","willTopic":"","willQos":"0","willPayload":""}]

SPARQL query settings (7)

Setting to execute a SPARQL Query using **GraphDB** endpoint via HTTP request.

The reference example is making use of the OpenSmartHomeDataSet:
https://github.com/linkedbuildingdata/SummerSchoolOfLDAC/blob/master/Notebooks/00-01-Check-Internet-Connection.ipynb

URL of endpoint
https://rdf.ontotext.com/4139541402/mydb/repositories/OpenSmartHomeDataSet

Headers

```
content-type = application/x-www-form-urlencoded
Accept = application/sparql-results+json
```

Get sensor ID

```
PREFIX express: <http://purl.org/voc/express#>
PREFIX bot: <https://w3id.org/bot#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX dog: <http://elite.polito.it/ontologies/dogont.owl#>
PREFIX seas: <https://w3id.org/seas/>
PREFIX dcterms: <http://purl.org/dc/terms/>
PREFIX skos: <http://www.w3.org/2004/02/skos/core#>
PREFIX ifc: <http://www.buildingsmart-tech.org/ifcOWL/IFC4_ADD1#>

SELECT ?SensorIdent
WHERE{
 ?ifcglobID express:hasString "05i4VutGDCsQKCrT6CQvhu" .
 ?roomIFC ifc:globalId_IfcRoot ?ifcglobID .
 ?room skos:related ?roomIFC .
 ?room bot:containsElement ?TempSensor .
 ?TempSensor rdf:type dog:TemperatureSensor .
 ?TempSensor seas:connectsAt/dcterms:identifier ?SensorIdent .
}
```

SPARQL query (7)

Node-RED
Deploy
filter nodes
Update
Query Sequence
Query SensorData
MQTT subscri
debug
input
inject
catch
status
link
mqtt
http
websocket
tcp
make request
Set URL & Headers
SPARQL query
finalize query
http request
Bindings
SensorID
all nodes
18/6/2019, 11:01:11 node: Bindings
msg.payload : Object
▼object
▶head: object
▼results: object
▼bindings: array[1]
▼0: object
▼SensorIdent: object
type: "literal"
value: "Room1Temp"
18/6/2019, 11:01:11 node: SensorID
msg : string[9]
"Room1Temp"

[{"id":"a76e66b2.880158","type":"inject","z":"3aa979e2.2262ce","name":"make
request","topic":"","payload":"","payloadType":"date","repeat":"","crontab":"","once":false,"onceDelay":"","x":250,"y":100,"wir
es":[["4df97275.4a4a64"]]},{"id":"7e5915c1.716c8c","type":"template","z":"3aa979e2.2262ce","name":"SPARQL
query","field":"payload","fieldType":"msg","format":"text","syntax":"plain","template":"PREFIX express:
<http://purl.org/voc/express#>\nPREFIX bot: <https://w3id.org/bot#>\nPREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-
ns#>\nPREFIX dog: <http://elite.polito.it/ontologies/dogont.owl#>\nPREFIX seas: <https://w3id.org/seas/>\nPREFIX dcterms:
<http://purl.org/dc/terms/>\nPREFIX skos: <http://www.w3.org/2004/02/skos/core#>\nPREFIX ifc: <http://www.buildingsmart-
tech.org/ifcOWL/IFC4_ADD1#>\n\nSELECT ?SensorIdent\nWHERE{\n?ifcglobID express:hasString \"05i4VutGDCsQKCrT6CQvhu\"
.\n?roomIFC ifc:globalId_IfcRoot ?ifcglobID .\n?room skos:related ?roomIFC .\n?room bot:containsElement ?TempSensor
.\n?TempSensor rdf:type dog:TemperatureSensor .\n?TempSensor seas:connectsAt/dcterms:identifier ?SensorIdent
.\n}","output":"str","x":480,"y":180,"wires":[["833db6ae.64fc98"]]},{"id":"2cd033af.416474","type":"http
request","z":"3aa979e2.2262ce","name":"","method":"POST","ret":"obj","paytoqs":false,"url":"","tls":"","proxy":"","authType":
"basic","x":410,"y":300,"wires":[["90db6f97.854c2","98d08d2d.3bce"]]},{"id":"90db6f97.854c2","type":"debug","z":"3aa979e2.
2262ce","name":"Bindings","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"payload","targetType":"
msg","x":660,"y":280,"wires":[]},{"id":"4df97275.4a4a64","type":"change","z":"3aa979e2.2262ce","name":"Set URL &
Headers","rules":[{"t":"set","p":"url","pt":"msg","to":"https://rdf.ontotext.com/4139541402/mydb/repositories/OpenSmartHo
meDataSet","tot":"str"},{"t":"set","p":"headers['content-type']","pt":"msg","to":"application/x-www-form-
urlencoded","tot":"str"},{"t":"set","p":"headers['Accept']","pt":"msg","to":"application/sparql-
results+json","tot":"str"}],"action":"","property":"","from":"","to":"","reg":false,"x":270,"y":180,"wires":[["7e5915c1.716c8c"]]},
{"id":"98d08d2d.3bce","type":"debug","z":"3aa979e2.2262ce","name":"SensorID","active":true,"tosidebar":true,"console":false
,"tostatus":false,"complete":"payload.results.bindings.SensorIdent.value","targetType":"jsonata","x":660,"y":320,"wires":[]},{"id
":"833db6ae.64fc98","type":"change","z":"3aa979e2.2262ce","name":"finalize
query","rules":[{"t":"set","p":"payload","pt":"msg","to":"\"query=\" &
payload","tot":"jsonata"}],"action":"","property":"","from":"","to":"","reg":false,"x":670,"y":180,"wires":[["2cd033af.416474"]]}]

Sistemi e Tecnologie Industriali Intelligenti
per il Manifatturiero Avanzato
Consiglio Nazionale delle Ricerche

That's all folks!

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