



LV-CAP Node-RED Application Developer Guide

Document Version: 01.00.00
Date: 24 May 2018

Version History

Date	Version	Author(s)	Notes
24/05/2018	01.00.00	Siôn Hughes	First Release

Final Approval

Approval Type	Date	Version	EA Technology Issue Authority

CONFIDENTIAL - This document may not be disclosed to any person other than the addressee or any duly authorised person within the addressee's company or organisation and may only be disclosed so far as is strictly necessary for the proper purposes of the addressee which may be limited by contract. Any person to whom the document or any part of it is disclosed must comply with this notice. A failure to comply with it may result in loss or damage to EA Technology Ltd or to others with whom it may have contracted and the addressee will be held fully liable therefor.

Care has been taken in the preparation of this Report, but all advice, analysis, calculations, information, forecasts and recommendations are supplied for the assistance of the relevant client and are not to be relied on as authoritative or as in substitution for the exercise of judgement by that client or any other reader. EA Technology Ltd. nor any of its personnel engaged in the preparation of this Report shall have any liability whatsoever for any direct or consequential loss arising from use of this Report or its contents and give no warranty or representation (express or implied) as to the quality or fitness for the purpose of any process, material, product or system referred to in the report.

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means electronic, mechanical, photocopied, recorded or otherwise, or stored in any retrieval system of any nature without the written permission of the copyright holder.

© EA Technology Ltd May 2018

Contents

1.	Introduction.....	1
2.	What is Node-RED?	1
3.	Deploying Node-RED application to Development Virtual Machine.....	2
4.	Node-RED Configuration.....	2
4.1	Configuration Parameters.....	3
5.	Using the Node-RED application as a flow editor.....	5
5.1	Creating a new flow	5
5.2	Deploying a flow	6
5.3	Exporting a flow	6
5.4	Importing a flow	7
6.	Use of the Node-RED email notification	8
7.	Useful information on use of the LV-CAP Node-RED application	9
7.1	Subscribing to an MQTT Topic	9
7.2	Unsubscribing from an MQTT Topic	9
7.3	Publishing to an MQTT Topic	10

1. Introduction

The Low Voltage Common Application Platform (LV-CAP) is a hardware agnostic software environment designed to accelerate the deployment of Smart Grid on electricity networks. The platform allows multiple “Smart” applications to be deployed on a single set of hardware and sensors, which all share data on an internal Data Marketplace. In order to allow rapid prototyping of algorithms and to encourage partners without software development resource to use the data available on the platform, EA Technology have developed an application which packages Node-RED for deployment to LV-CAP compatible platforms.

This document details how to deploy and configure the LV-CAP Node-RED application and documents an example flow developed allowing email notification when a measurement passes a defined threshold.

This document should be used alongside the LV-CAP Developer Guide (*2622-MANUL-S001-V02.02.02 Developing for LV-CAP using the Virtual machine*) and LV-CAP Public API (*2383-MANUL-V04.03.04 LV Common Application Platform Public API*) as this document refers to both throughout.

2. What is Node-RED?

Node-RED (<https://nodered.org/>) is a development tool intended to allow easy connection of data, web services and hardware in a visual format using pre-defined blocks of functionality called nodes. It allows simple drag and drop elements allowing data from one source to be passed onto another, with the ability to write complex functionality using the JavaScript programming language.

A collection of nodes are called flows. Flows can be exported from one instance of Node-RED and imported onto other instances allowing functionality to be defined once then deployed to many systems. The LV-CAP Node-RED application allows exported flows to be placed into the application’s configuration file for automatic import and running of flows.

Having Node-RED on the LV-CAP platform allows the rich data sets available from the Data Marketplace to be made available to users and third parties who may now have the resource to develop a packaged application or instead might want to quickly prototype a concept. Some example flow concepts for the LV-CAP platform include:

- Email notification when a sensor measurement exceeds a set threshold (see example in section 6)
- Prototyping of a new data processing algorithm through implementing it in JavaScript
- Calculating of metrics from incoming sensor data and publish them back to the Data Marketplace

3. Deploying Node-RED application to Development Virtual Machine

A virtualised LV-CAP environment is available to potential users of the LV-CAP platform. This allows Applications to be built, run and tested without needing access to a physical hardware platform. Instructions on getting started with the virtual development environment and accessing the system are included in section 3 and 4 respectively of the LV-CAP Developer Guide. Follow these instructions before proceeding.

Once the virtualised LV-CAP environment is running, section 5.2 of the LV-CAP Developer Guide details how to deploy the application (*imconsulting_node-red_00.tar*) to the platform. The following configuration entry needs to be added to the Container Manager's configuration:

```
"containerName": "imconsulting_node-red_00",
  "File": "imconsulting_node-red_00.tar",
  "imageTimestamp": 1522710676,
  "DockerParams": {
    "containerName": "imconsulting_node-red_00",
    "imageID": "imconsulting/node-red:1.0.0"
  }
}
```

4. Node-RED Configuration

Before the application enters normal operation, it requires a configuration file to be available. A default configuration is supplied along with the application binary file. An empty *ContainerConfig* object within the configuration file can be sent to the application, which will then make the application use its inbuilt default values. Deployment of configuration is documented in section 5.2 of the LV-CAP Developer Guide.

The configuration of the Node-RED application contains the flows for the application to run.

Note: on receiving a new configuration, the Node-RED application will restart losing any changes within the Editor and disrupt any currently running flows.

4.1 Configuration Parameters

The configuration parameters and the expected JSON structure of the application configuration along with their default values are documented below.

```

{
  "ContainerName": "imconsulting_node-red_00",
  "ContainerConfig": {
    {
      "flows": [],
      "adminRoot": "/editor",
      "adminAuth": [{
        "username": "admin",
        "password":
"$2a$08$zZWtXTja0fB1pzD4sHCMYOCMYz2Z6dNbM6t18sJogENOMcxWV9DN.",
        "permissions": "*"
      }],
      "auth": {
        "username": "user",
        "password":
"$2a$08$zZWtXTja0fB1pzD4sHCMYOCMYz2Z6dNbM6t18sJogENOMcxWV9DN."
      },
      "nodeRoot": "/"
    }
  }
}

```

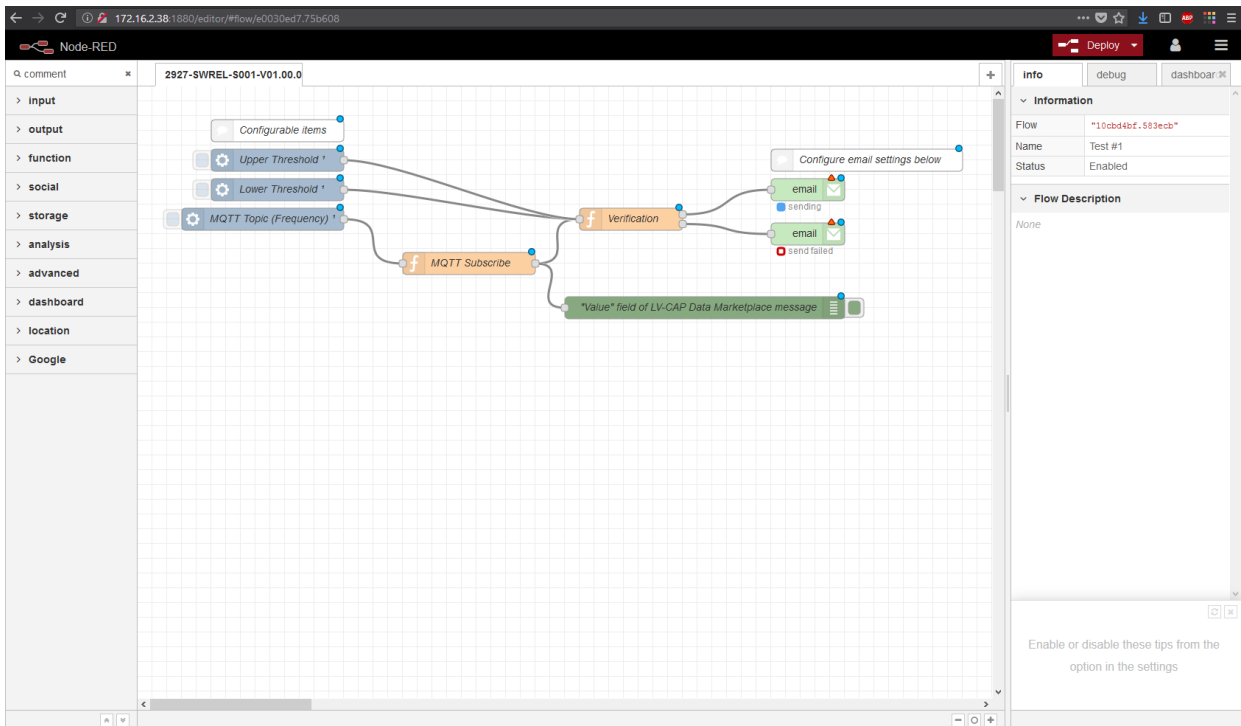
Parameter	Description	Default Value
ContainerName	Required field by the LV-CAP platform. This field contains the name of the application. This field should not be changed.	N/A
ContainerConfig	JSON Object encapsulating the specific configuration of the application	Empty
flows	Within this object exported Node-RED flows in JSON format are to be placed	Empty
adminRoot	This is the URL used to access the Editor UI. If there is a need to disable the Editor, set to false.	"/editor"
adminAuth	Object encapsulating the "username", "password" and "permissions" objects which control the access credentials to the Editor UI. "permissions" allowable settings are "*" for read and write access, "read" for read only. Passwords entered here need to encrypted using a BCrypt hash. This can be done on sites similar to: https://bcrypt-generator.com/	Username: admin Password: password Permissions: *
auth	Object encapsulating the "username", and "password" objects which control	Username: user

	the access credentials to the dashboard and other generated UIs. As above, passwords entered here need to encrypted using a BCrypt hash.	Password: password
nodeRoot	This is the root URL used by Node-Red to display flow outputs. It will be prepended to any URL node defined in the flows	“/”

5. Using the Node-RED application as a flow editor

Node-RED has an in-built flow editor making it possible for flows to be created and tested on the LV-CAP platform directly from a browser. Assuming the default configuration is in place, navigate to <http://<IP>:1880/editor/#flow/e0030ed7.75b608> from a web browser, where <IP> is the IP address of the LV-CAP virtual machine as used to connect to the platform for application deployment in section 2 of this document. The credentials to login into the editor are included within the configuration file, but if using the defaults these are “admin” and “password” respectively.

Upon logging an editor similar to below will be displayed.



Node-RED Flows included within the applications’ configuration will automatically show within the editor.

5.1 Creating a new flow

To create a new flow, click the “+” symbol in the top right hand of the central flow display pane. This will create a new tab on the central pane for developing the flow. The flow can be named and some notes added to it for documentation by double clicking the tab to open the property editor window.

To add elements to a flow, drag a node from the left hand side toolkit onto the flow display pane. Nodes are packaged pieces of functionality which can outputs of can be connected to the input of another, e.g. output of an “inject” button click to a “function” which may generate a random number and then output to an “email” node for notification. Hovering over a node brings up a description of what that node does.

In addition to the standard nodes within Node-RED additional nodes such as Twitter, Dropbox, Google Charts and Facebook Messenger are available within the LV-CAP Node-Red application.

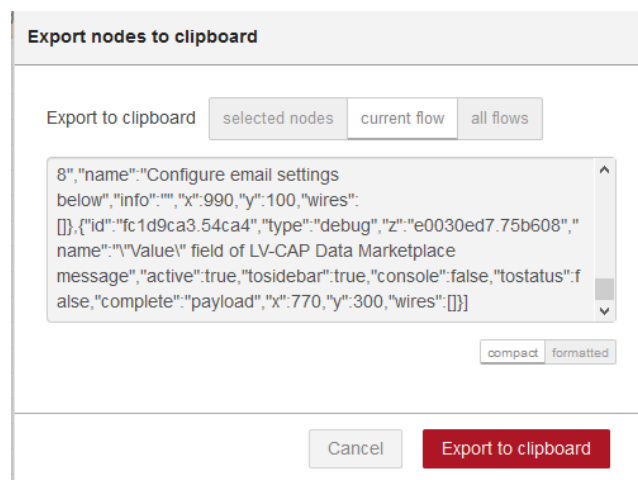
5.2 Deploying a flow

Once a flow has been developed, it needs to be deployed to run. To deploy a flow, click the red “Deploy” button in the top right-hand corner of the Editor UI. This will start the flow running.

Note: Deploying a flow does not save the flow (by adding it to the application’s configuration). When the Node-RED Application (or LV-CAP) is restarted, it will be deleted and not run.

5.3 Exporting a flow

To add a developed flow to the application’s configuration, it first needs to be exported. To do this, click on a node in your flow to select it, then click the menu button in the top right hand corner of the editor UI (three lines in a vertical stack), then navigate to export > clipboard. A new export window will be displayed similar to below.

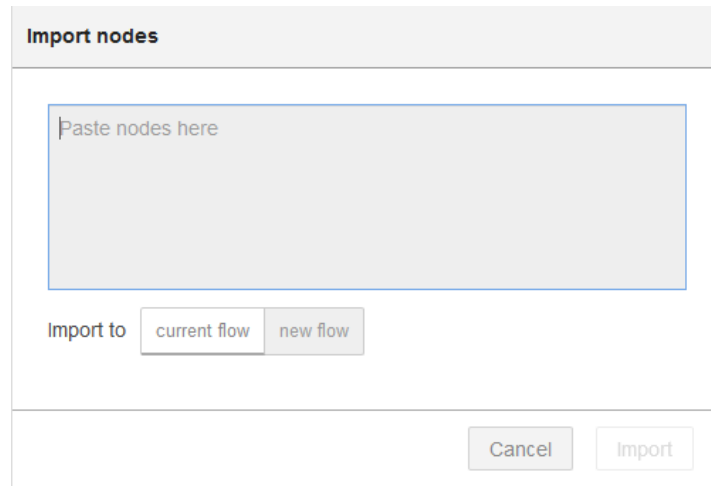


The following process should then be followed:

- Click on “current flow” at the top of the window to select all nodes within the current flow
- Click on “compact” which is located under the large text box
- Click on “Export to clipboard” at the bottom of the window to export to the clipboard, allowing it to be pasted into a text editor.
- Open the Node-RED Application configuration file in a text editor
- Locate the "flows" entry in the configuration file, and paste the exported flow within the square brackets ([]) ensuring that the leading and trailing square brackets from the exported flow are removed. Subsequent flows, must be separated by a comma.

5.4 Importing a flow

In a similar manner to exporting of a flow, flows can be imported for debugging purposes. To do, so click the menu button in the top right-hand corner of the editor UI (three lines in a vertical stack), then navigate to import > clipboard. A new import window will be displayed similar to below.



The image shows a dialog box titled "Import nodes". It contains a large text input field with the placeholder text "Paste nodes here". Below the text field, there is a label "Import to" followed by two buttons: "current flow" and "new flow". At the bottom right of the dialog, there are two buttons: "Cancel" and "Import".

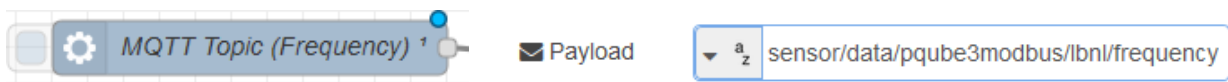
Paste the JSON format flow into the text box, select whether it should be imported into a new flow or into the current, then click the "Import" button. If imported to the current flow, the nodes will be added to the current flow.

6. Use of the Node-RED email notification example

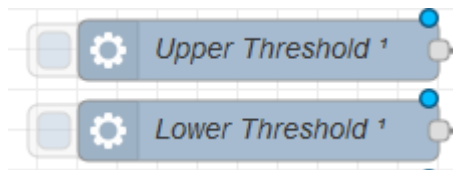
An example email flow has been developed along with the application to demonstrate the functionality of Node-RED and its integration with the LV-CAP platform data. This example flow (2927-SWREL-S001-V01.00.00 *Example Email Flow*) subscribes to a single topic, compares incoming values from the topic against an upper threshold, which when it exceeds this sends an email notification. Once the incoming value drops below a lower threshold, an email notification is then sent informing of this.

This example flow can be easily configured to monitor a different Data Marketplace topic with different upper and lower thresholds through changing three node properties only.

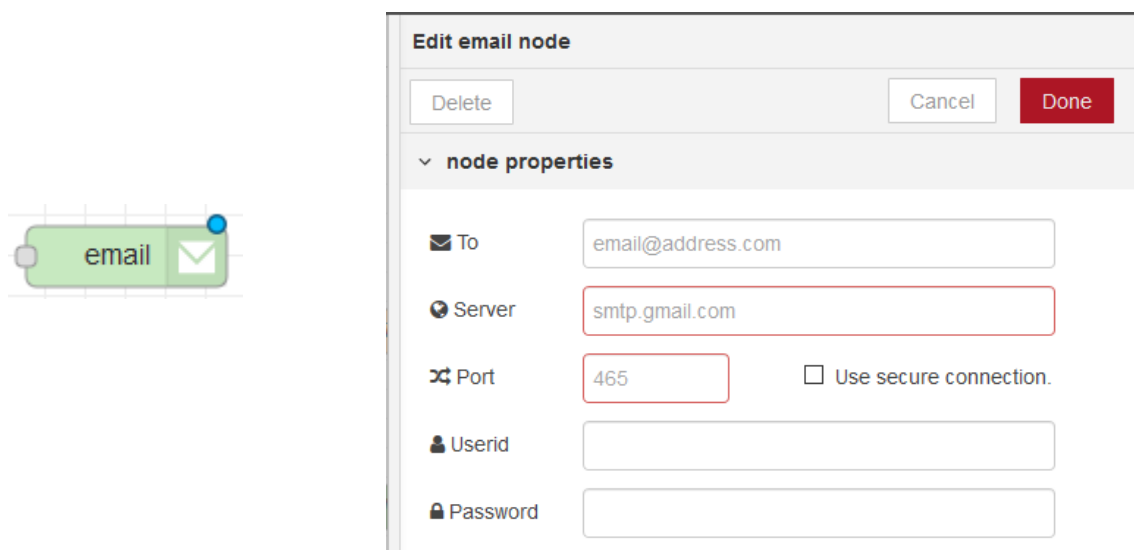
To change the topic subscribed to, double click on the “MQTT Topic (Frequency)” node and change the *Payload* value associated with it to the desired topic.



Changing the upper and lower thresholds to compare against, is done in a similar manner through clicking on the “Upper Threshold” or “Lower Threshold” nodes and changing the associated *Payload* value.



To enable email notifications, configuration and credentials for the email account to use to send email and the recipient must be configured. This can be done by double clicking on the email nodes within the flow and entering the parameters required.



7. Useful information on use of the LV-CAP Node-RED application

As Node-RED is running within an application on the LV-CAP platform it has some things useful shortcuts to aid development and some pitfalls to beware of. These are documented in the following sections.

7.1 Subscribing to an MQTT Topic

Instead of using the in-built MQTT node to subscribe to a topic on the data marketplace, a snippet of JavaScript code must be used to do this instead. The Data Marketplace has a high level of security in place which only allows certain applications access to certain privileges. Because of this, the Node-RED application authenticates itself with an inbuilt security key, which flows running within the application can take advantage of. Copy and paste the below snippet into a *function* node within a flow to subscribe to a topic and receive the JSON payload as output.

```
var lvcap = {
  sub: global.get('lvcapSub')
};

lvcap.sub('mqtt/topic/here', function (message) {
  //callback on message received and send JSON object to output node
  node.send({payload: message});
});
```

The payload of messages received from this subscription are output from the function node, and can be used within other nodes. For example, the *Value* field within the JSON payload of API compliant messages is available within a *Debug* node through accessing the *msg.payload.Value* member. The *Value* element can be replaced for any other expected fieldname, such as *Timestamp*, *Valid*, or *ToStore* for example.

7.2 Unsubscribing from an MQTT Topic

Similar to subscribing to an MQTT topic, a snippet of JavaScript code can be used to unsubscribe from an MQTT topic. **Note: Do not unsubscribe from the # wildcard topic as this will stop the application running as it will not respond to status requests from the Container Manager**

```
var lvcap = {
  unsub: global.get('lvcapUnsub')
};

lvcap.unsub('mqtt/topic/here', function() {
  //optional callback on successful unsubscribe
});
```

7.3 Publishing to an MQTT Topic

Similar to subscribing and unsubscribing to/from an MQTT topic, a snippet of JavaScript code can be used to publish to an MQTT topic. This snippet accepts a JSON formatted input to publish onto the given topic. All published data must conform to the JSON standard set out in section 9 of the LV-CAP Public API document **Note: Due to Access Control restrictions in place on the platform, only topics starting with *algorithm/data/imconsulting_node-red_00* will be published to the Data Marketplace.**

```
var lvcap = {
  pub: global.get('lvcapPub')
};

lvcap.pub('mqtt/topic/here', JSON.stringify(msg.payload), function () {
  //optional callback on successful publish
});
```

Safer, Stronger,
Smarter Networks

www.eatechnology.com
Australia | China | Singapore | UAE | Europe | USA

Main reception: +44(0) 151 339 4181
EA Technology, Capenhurst Technology Park,
Capenhurst, Chester, CH1 6ES, United Kingdom

Safer, Stronger,
Smarter Networks

www.eatechnology.com
Australia | China | Singapore | UAE | Europe | USA

Main reception: +44(0) 151 339 4181
EA Technology, Capenhurst Technology Park,
Capenhurst, Chester, CH1 6ES, United Kingdom

Safer, Stronger,
Smarter Networks

www.eatechnology.com
Australia | China | Singapore | UAE | Europe | USA

Main reception: +44(0) 151 339 4181
EA Technology, Capenhurst Technology Park,
Capenhurst, Chester, CH1 6ES, United Kingdom

Global Footprint

We provide products, services and support for customers in 90 countries, through our offices in Australia, China, Europe, Singapore, UAE and USA, together with more than 40 distribution partners.



Our Expertise

We provide world-leading asset management solutions for power plant and networks.

Our customers include electricity generation, transmission and distribution companies, together with major power plant operators in the private and public sectors.

- Our products, services, management systems and knowledge enable customers to:
- Prevent outages
- Assess the condition of assets
- Understand why assets fail
- Optimise network operations
- Make smarter investment decisions
- Build smarter grids
- Achieve the latest standards
- Develop their power skills

Safer, Stronger,
Smarter Networks

www.eatechnology.com
Australia | China | Singapore | UAE | Europe | USA

Main reception: +44(0) 151 339 4181
EA Technology, Capenhurst Technology Park,
Capenhurst, Chester, CH1 6ES, United Kingdom