A Brief Introduction to Node-RED
A Visual Flow-based Programming Tool

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NFARL CLUB PRESENTATION

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Node-RED

Node-RED is Flow-Based Programming

- Node-RED was originally developed by IBM’s Emerging Technology Services team in 2013.
- It was intended to be a proof-of-concept to manipulate data in a simple and intuitive way.
- It soon became much more with the realization that it can be extended in any direction. It’s “low-code” paradigm makes it easy to learn, even for non-programmers.

Node-RED is free and accessible

- Node-RED was released to the Open Source community, making it free for all to use.
- Node-RED can be installed on Windows, Linux, and Raspberry Pi Operating Systems. Node-RED can also be hosted in the Cloud.
- The Node-RED user interface is accessed from a web browser, so you can work with Node-RED on a Windows machine, even though it could running on a Raspberry Pi.

Flows and Nodes

- Node-RED is a tool that allows a programs (called ***Flows***) to be created using graphical “black boxes” of code contained in ***Nodes***.

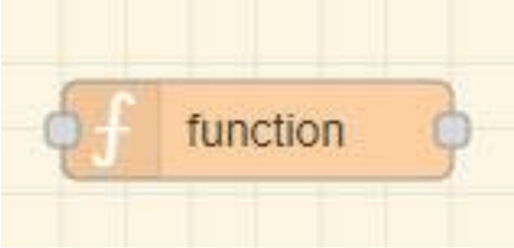
- ***Nodes*** are designed to perform a defined purpose and hide that complexity from the user. This allows the user to concentrate on the task they’re trying to implement.

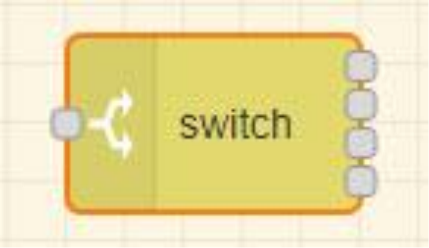
- ***Nodes*** typically accept data as an input, manipulate it in some way, then pass it on to other nodes.

Nodes – Prewritten code you can reuse

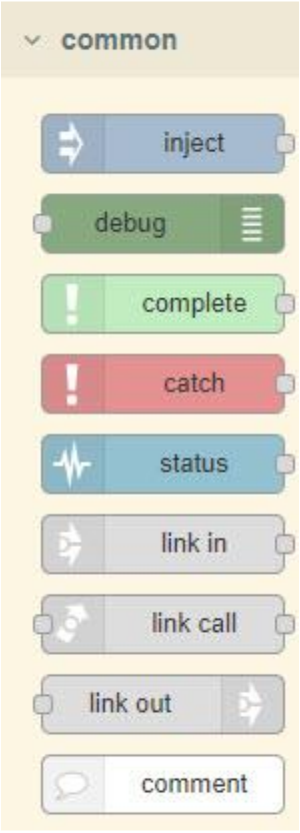
- Nodes encapsulate programming logic written in JavaScript and Python. You can leverage what others have already written.

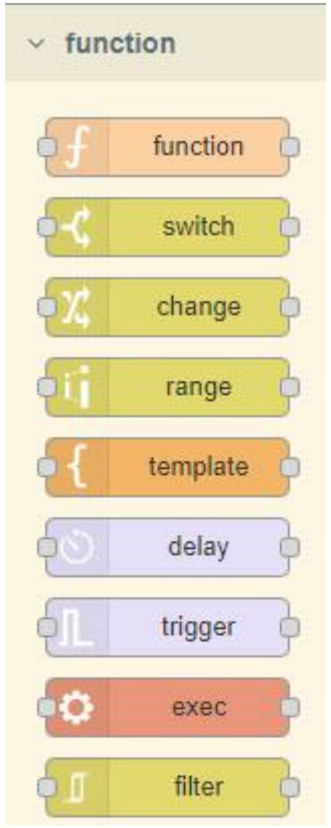
- Nodes typically have at least one input and output signified by the grey dots. Some node types have multiple outputs.

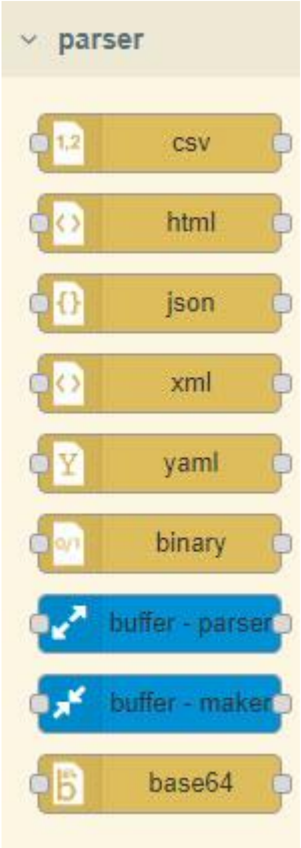


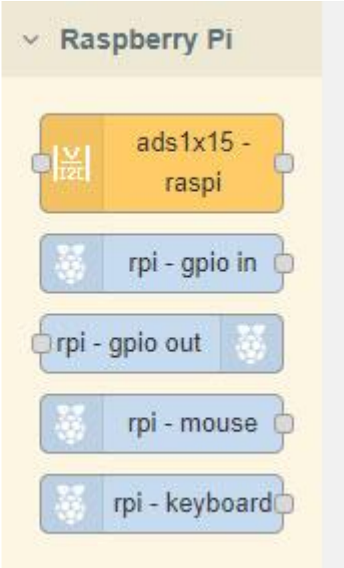


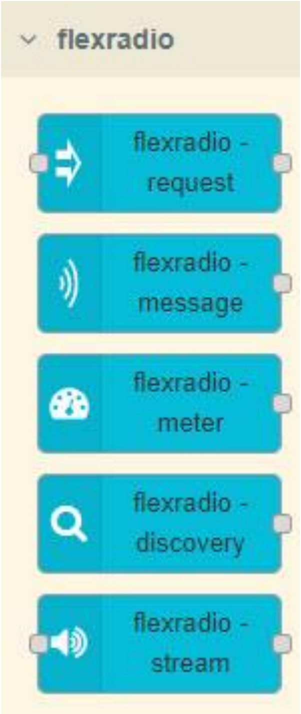
Nodes are organized in the Palette







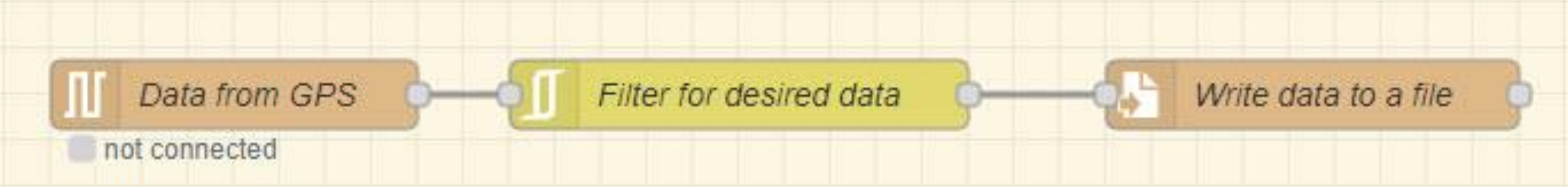




There are hundreds of nodes to choose from.
More can easily be installed in the Palette.
Advanced users can create their own nodes.

Wires direct the flow of data

- Nodes are connected with ***wires*****.** Data is passed from one node to the next based on the wire connections.



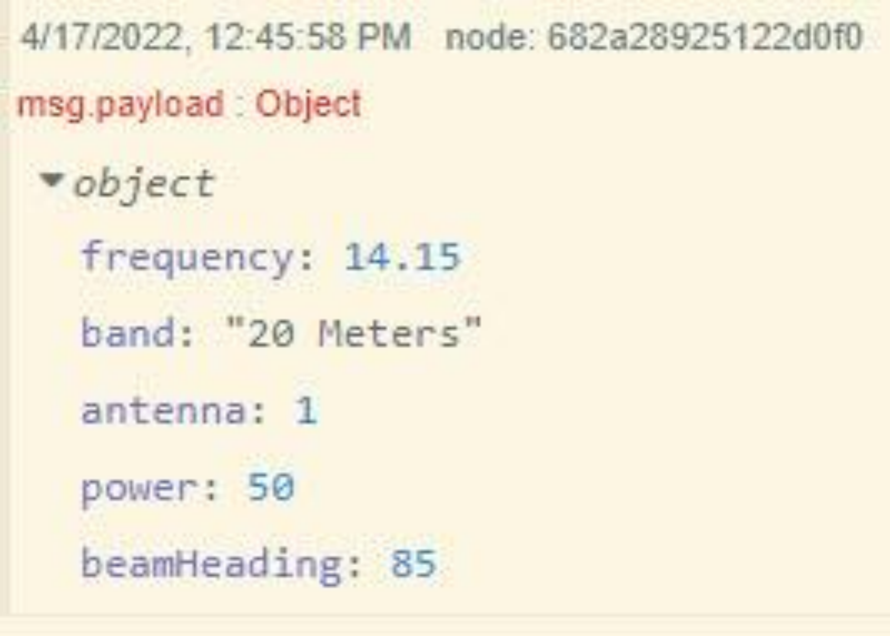
This example gathers GPS location data and writes it to a file.

Data is passed from Node to Node as Messages

- Since the underlying language of Node-RED is JavaScript, messages are passed between nodes as JavaScript objects. These are just data *containers* that organize the data into clearly defined properties.

  This example message object has properties related to the operating conditions of an HF radio and antennas.

  Typically, the ***msg.payload*** property is used most often between nodes.

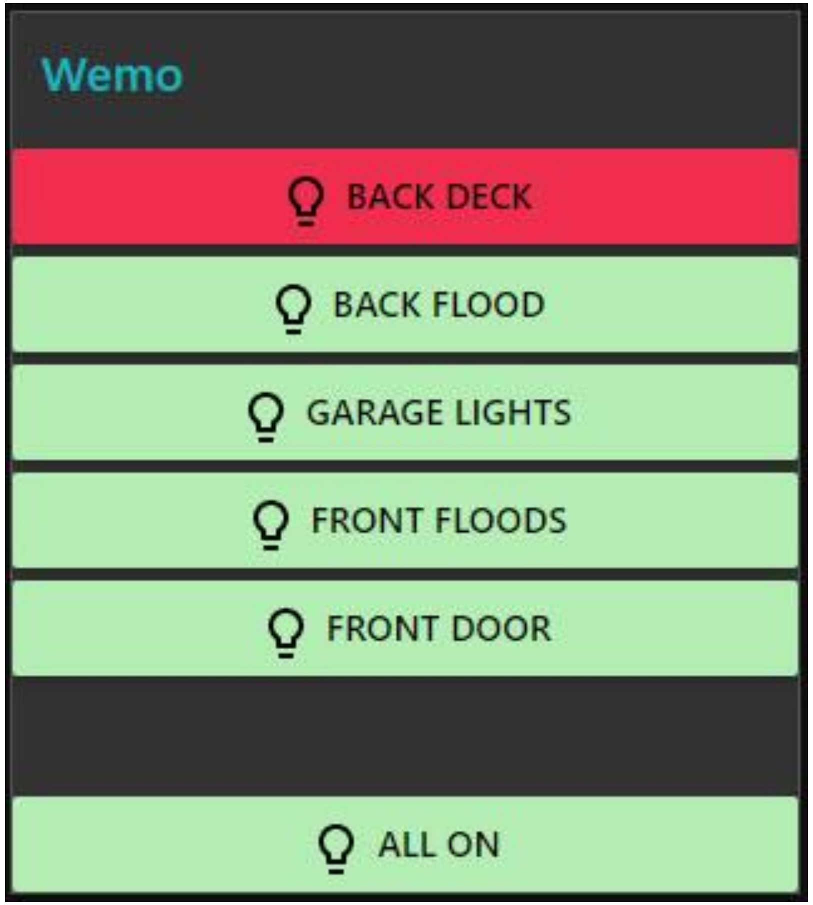


```
4/17/2022, 12:45:58 PM   node: 682a28925122d0f0
msg.payload : Object
 ▾object
   frequency: 14.15
   band: "20 Meters"
   antenna: 1
   power: 50
   beamHeading: 85
```

Example: Belkin WeMo Switch Dashboard

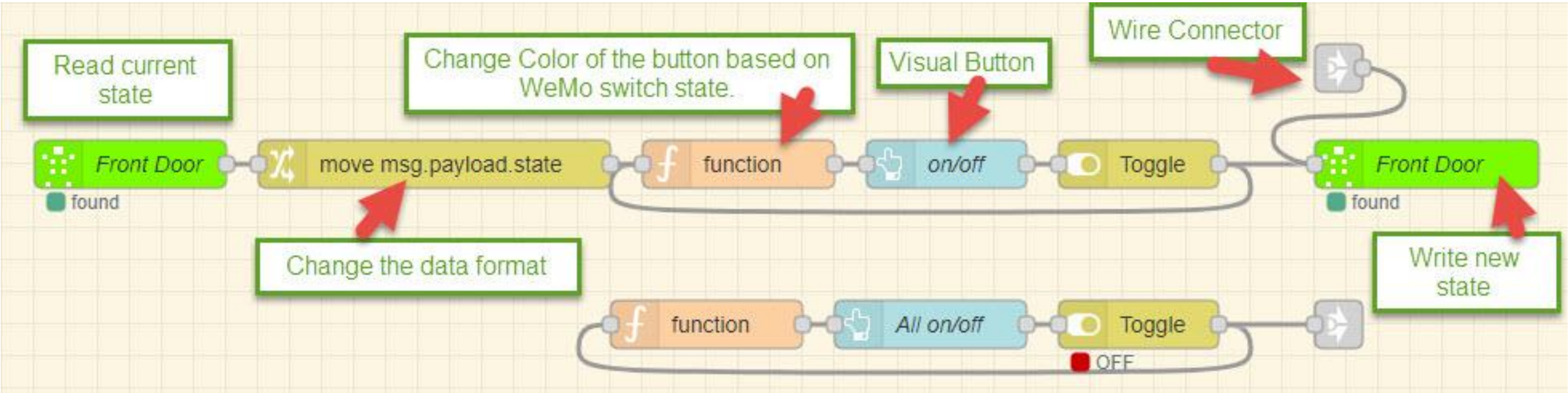
The visual nodes in a flow, display items in the Node-RED ***Dashboard***. It’s just a webpage rendered in a web browser. Works well on smart phones too.

This is how the WeMo Flow looks when rendered in the web browser. In this case, the red background indicates the light is turned on.



WeMo Flow has Visual Elements

- Flows can also have visual elements. This gives you a powerful way to create complex web pages (***Dashboards***) that control hardware.



This is a portion of a flow that controls Belkin WeMo switches.
The blue color nodes display a button in the Dashboard.

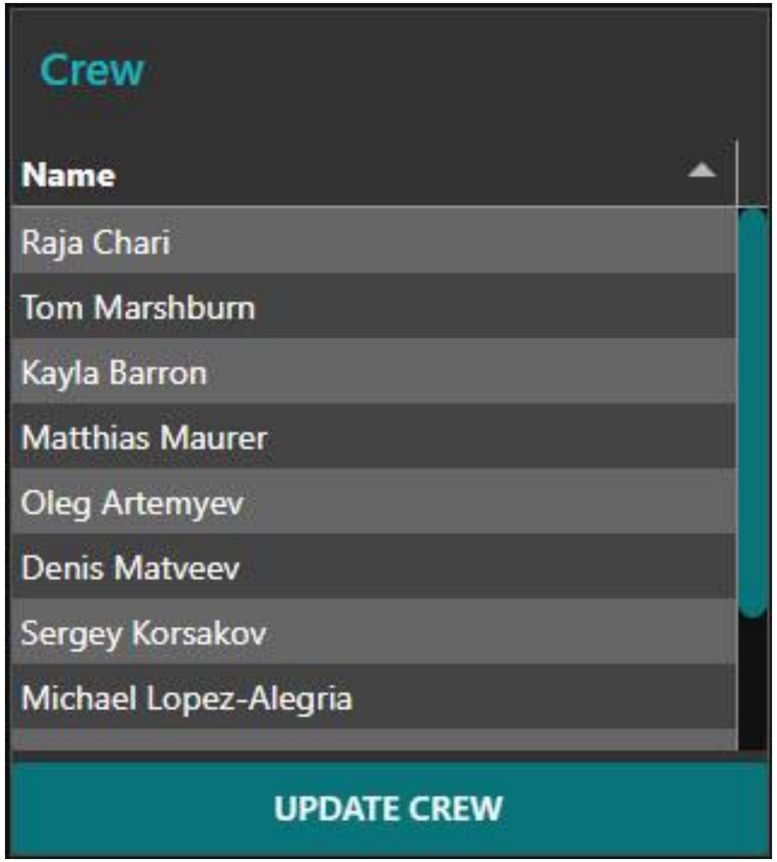
Ctrl+Click to download the complete flow

Example: IIS Crew – Text to Speech

- Node-RED has a Text-to-Speech node. It's easy to create flows that vocalize written text.

- In this flow, the current crew names are fetched from the Internet, listed, then audibly announced in the configured language.

- This could easily be used for announcing information for the visually impaired.

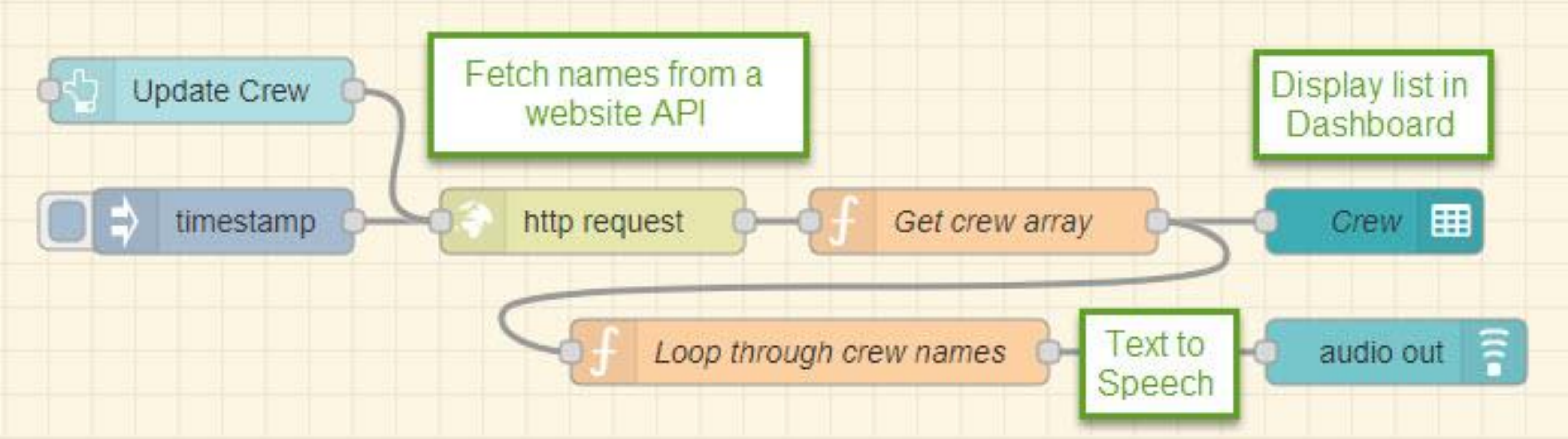


Crew

Name
Raja Chari
Tom Marshburn
Kayla Barron
Matthias Maurer
Oleg Artemyev
Denis Matveev
Sergey Korsakov
Michael Lopez-Alegria

Example: IIS Crew uses the Audio Out Node

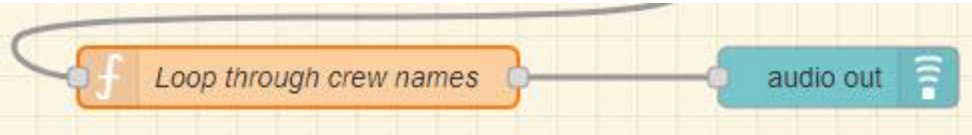
This flow gathers the active IIS Crew and speaks their names.

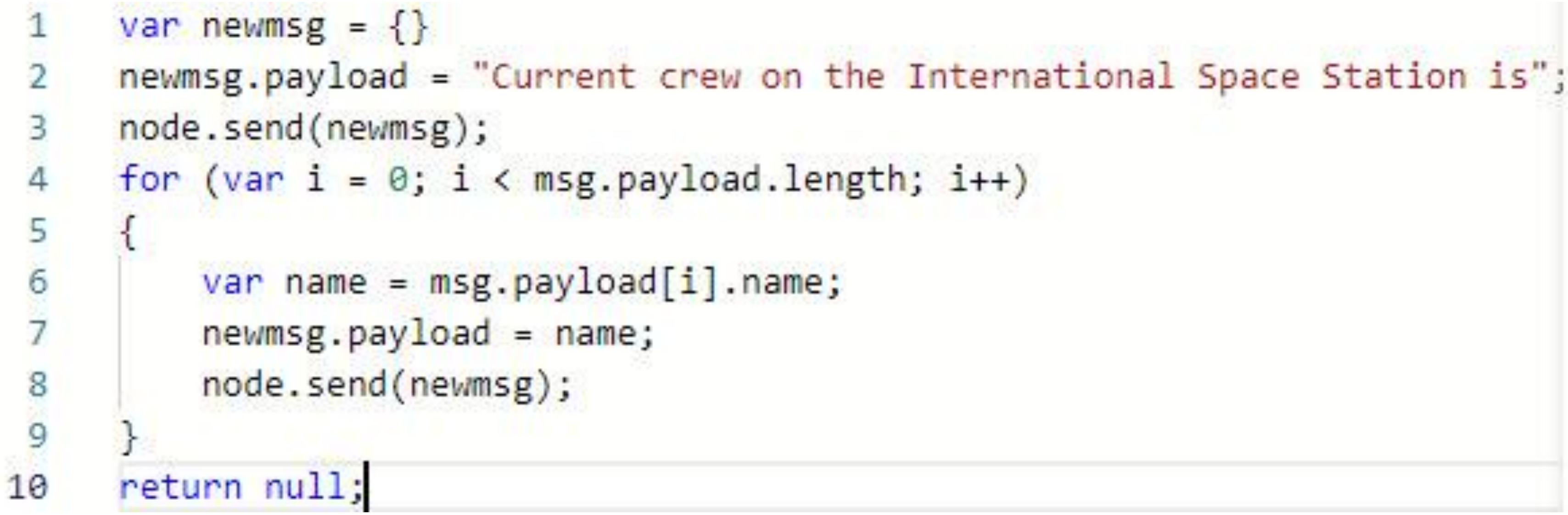


Ctrl+Click to download this Flow

A brief look at real code that you might write

JavaScript code in the function node. It loops through the array of crew names passed in as msg.payload and sends each element out to the audio out node.





```
var newmsg = {}
newmsg.payload = "Current crew on the International Space Station is";
node.send(newmsg);
for (var i = 0; i < msg.payload.length; i++)
{
    var name = msg.payload[i].name;
    newmsg.payload = name;
    node.send(newmsg);
}
return null;
```

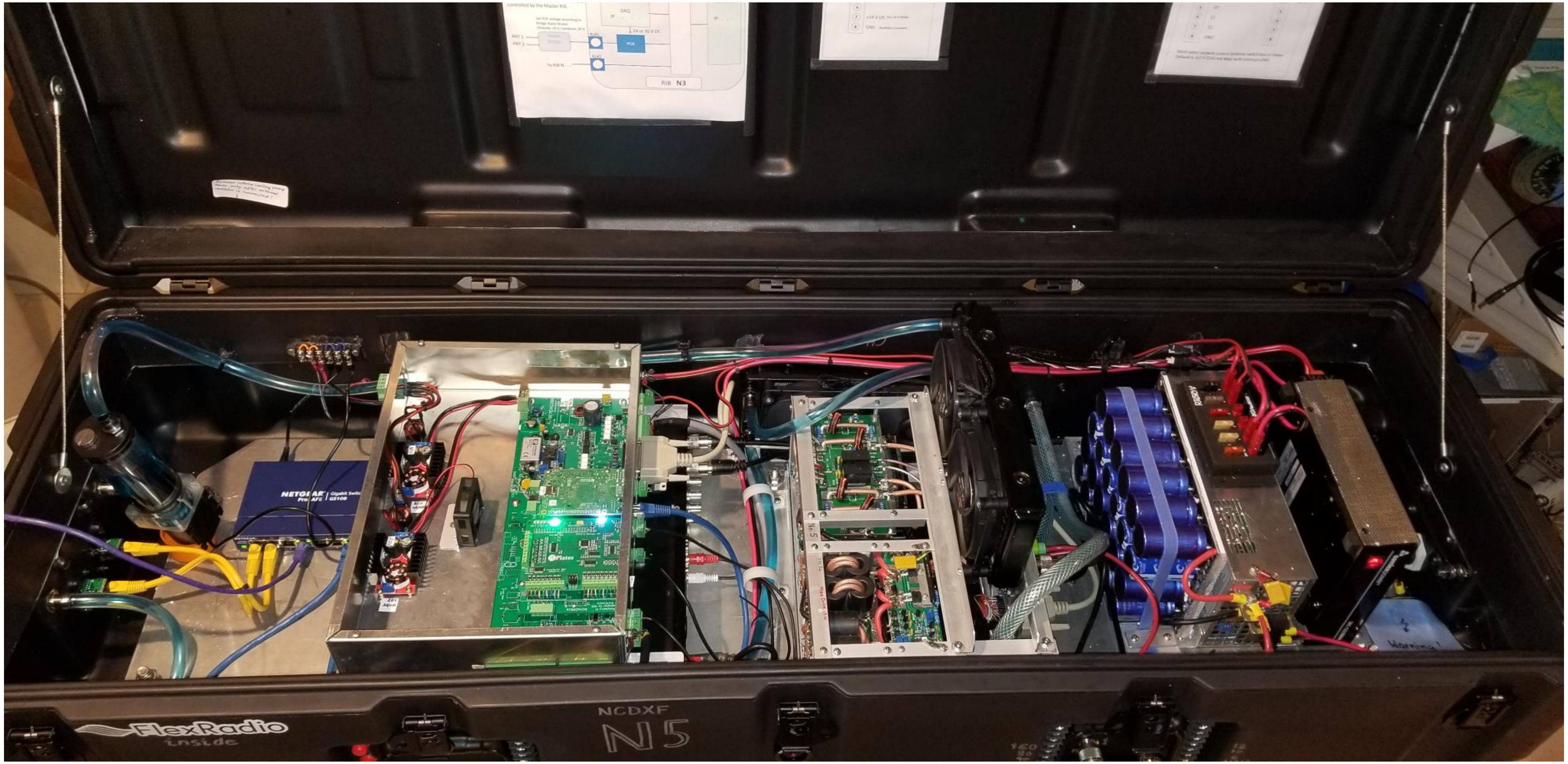
Real-life Node-RED in action

THE RADIO-IN-A-BOX PROJECT OF THE NCDXF

A RAPID DEPLOYABLE STATION FOR DXPEDITIONS

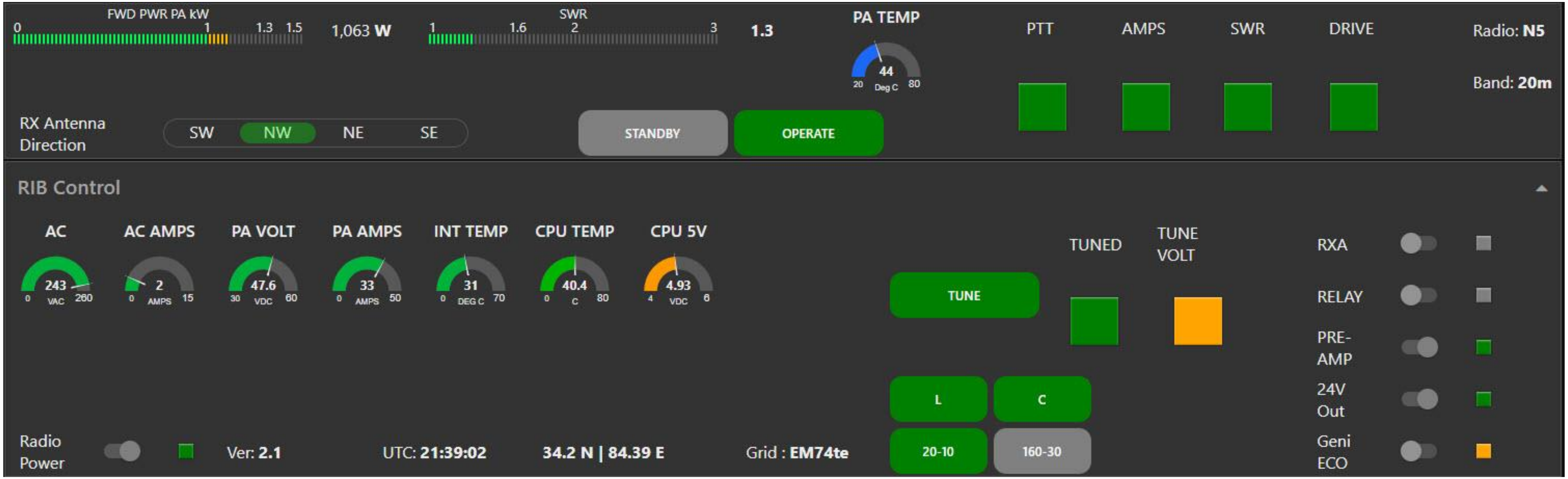
RIB – Radio In a Box

Contains a Flexradio 6700, 1KW PA, power supplies & water cooling



This is the Radio In a Box Dashboard in Operation

The RIB requires many command/control parameters to be monitored using A/D data acquisition of voltage and RF power.



FWD PWR PA kW 1,063 W

SWR 1.3

PA TEMP 44 Deg C

Radio: **N5**

Band: **20m**

RX Antenna Direction SW [✓ NW] NE SE

RIB Control

AC 243 VAC

AC AMPS 2 AMPS

PA VOLT 47.6 VDC

PA AMPS 33 AMPS

INT TEMP 31 DEG C

CPU TEMP 40.4 C

CPU 5V 4.93 VDC

Ver: **2.1**

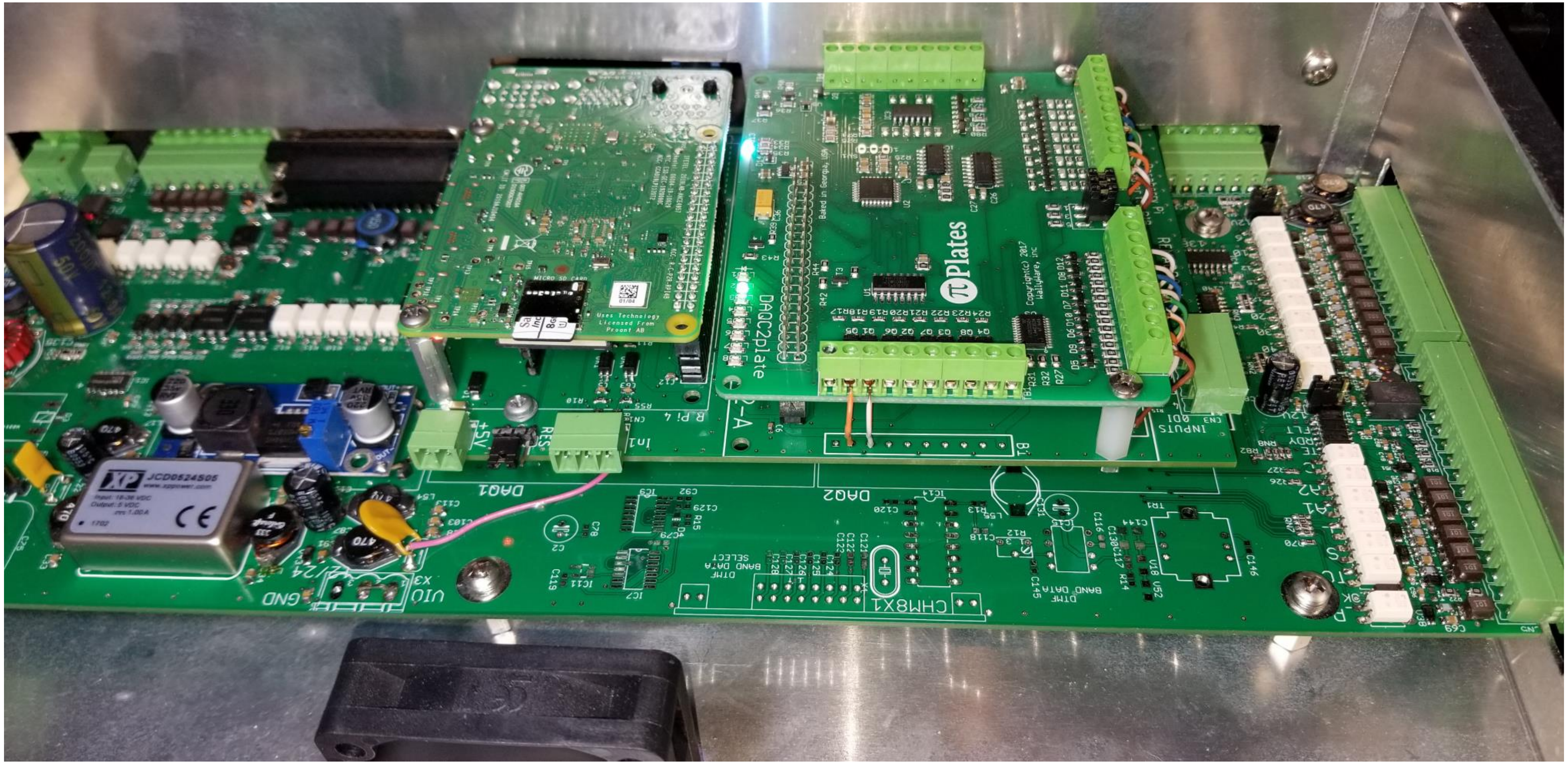
UTC: **21:39:02**

34.2 N | 84.39 E

Grid : **EM74te**

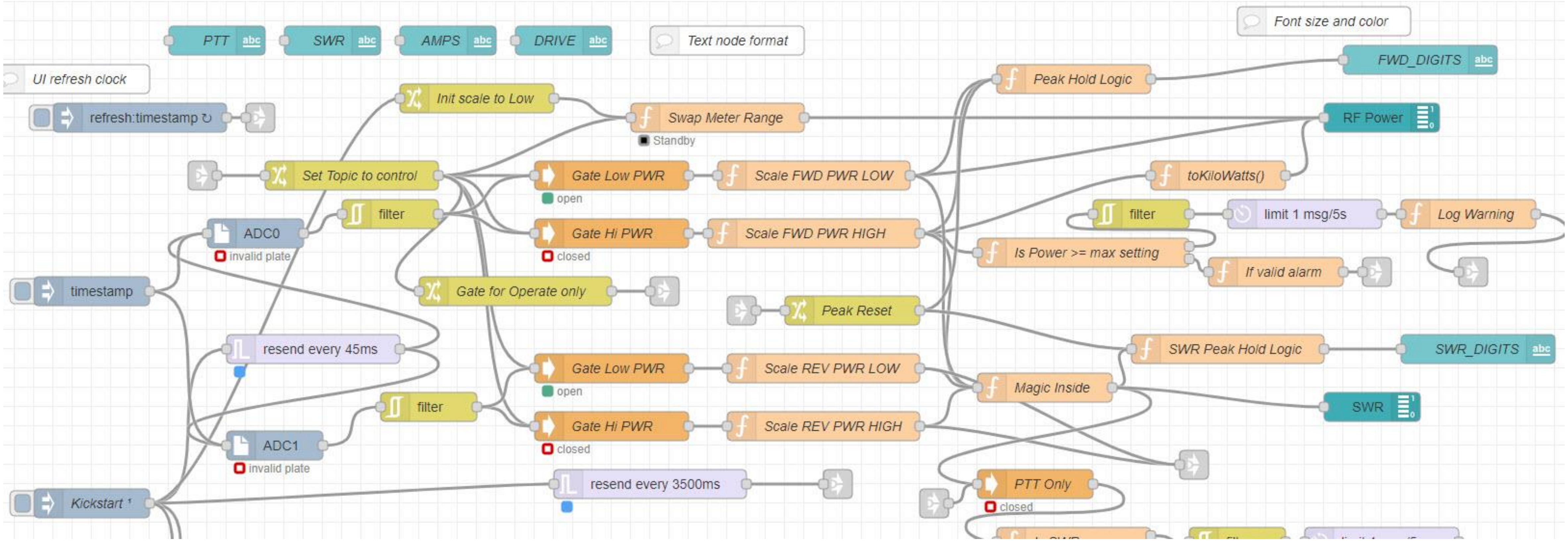
Node-RED runs well on Raspberry Pi 3/4

This is the RIB controller. Pi on left, Analog-to-Digital Hat on right.



Flows can get quite complex

This is only a small portion of the flows I used for the RIB project



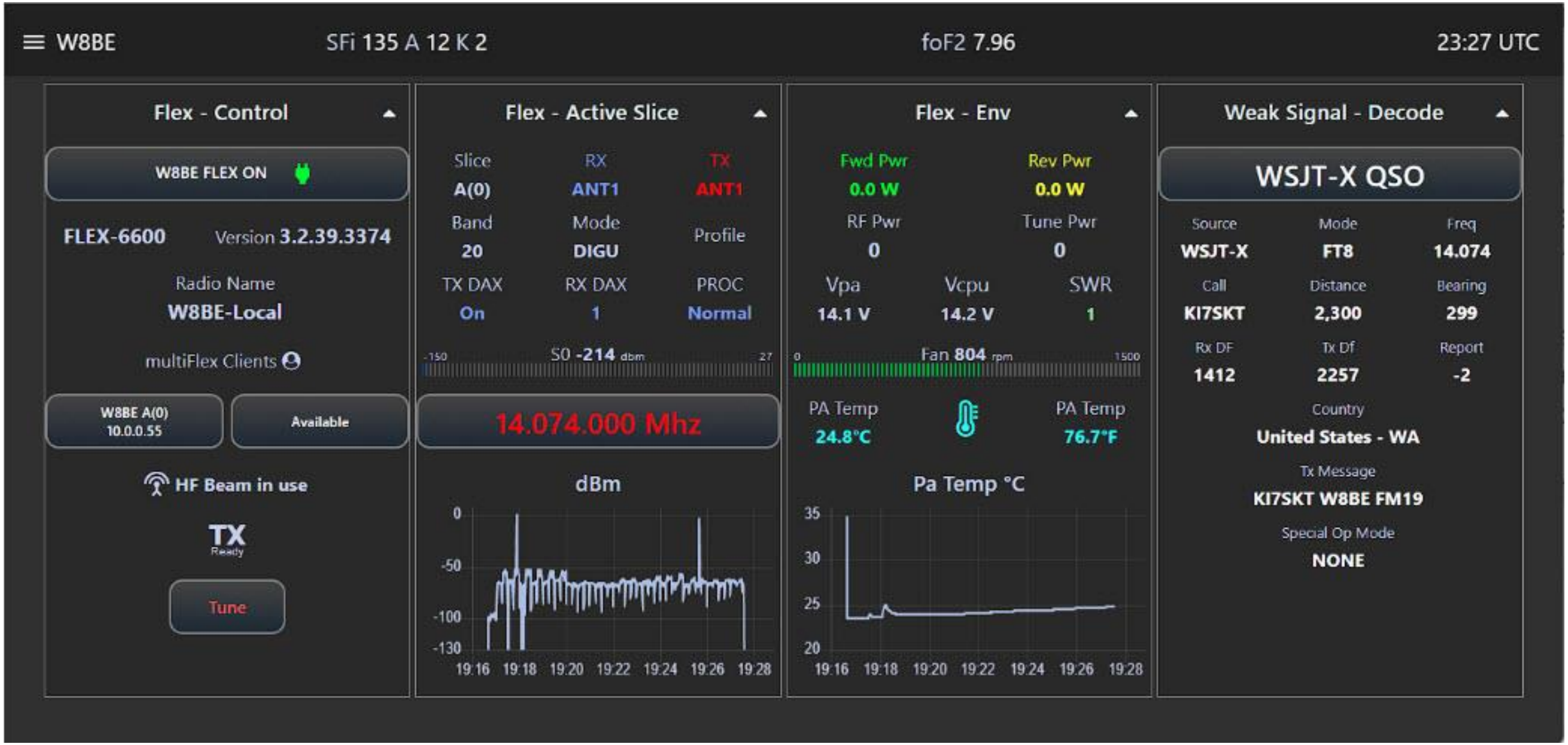
What can I use it for?

JUST ABOUT ANYTHING YOU WANT TO AUTOMATE ESPECIALLY IN THE HAM SHACK

Node-RED

Here are a few of the Node-RED dashboards created by users on the **nodered-hamradio** email list on groups.io

Ham Shack Dashboards (W8BE)



W8BE SFi 135 A 12 K 2 foF2 7.96 23:27 UTC

Flex - Control

W8BE FLEX ON

FLEX-6600 Version 3.2.39.3374

Radio Name
W8BE-Local

multiFlex Clients

W8BE A(0) 10.0.0.55 | Available

HF Beam in use

TX Ready

Tune

Flex - Active Slice

Slice	RX	TX
A(0)	ANT1	ANT1
Band	Mode	Profile
20	DIGU	
TX DAX	RX DAX	PROC
On	1	Normal

-150 S0 -214 dbm 27

14.074.000 Mhz

Flex - Env

Fwd Pwr	Rev Pwr
0.0 W	0.0 W
RF Pwr	Tune Pwr
0	0

Vpa	Vcpu	SWR
14.1 V	14.2 V	1

0 Fan 804 rpm 1500

PA Temp 24.8°C PA Temp 76.7°F

Weak Signal - Decode

WSJT-X QSO

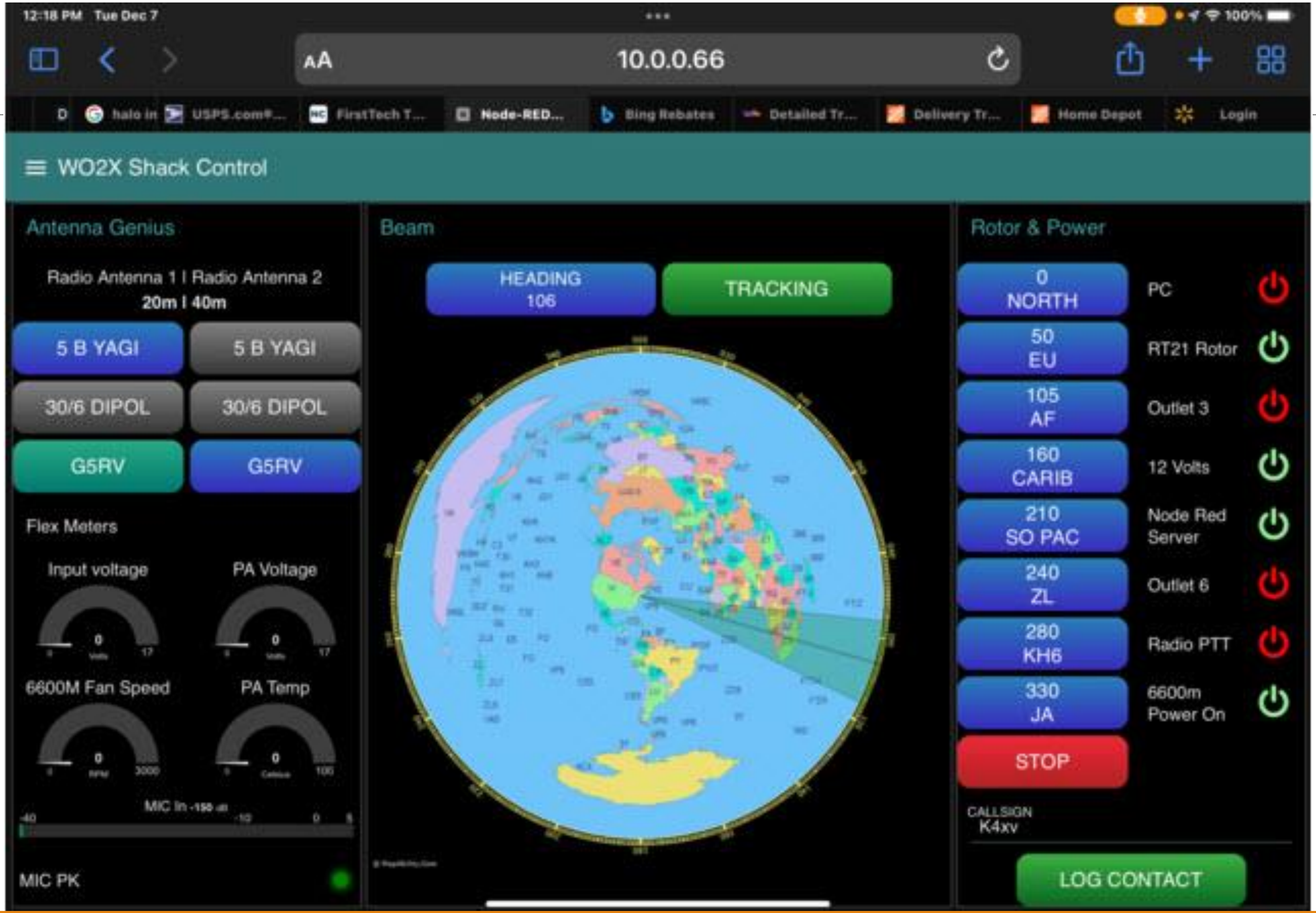
Source	Mode	Freq
WSJT-X	FT8	14.074
Call	Distance	Bearing
KI7SKT	2,300	299
Rx DF	Tx Df	Report
1412	2257	-2

Country
United States - WA

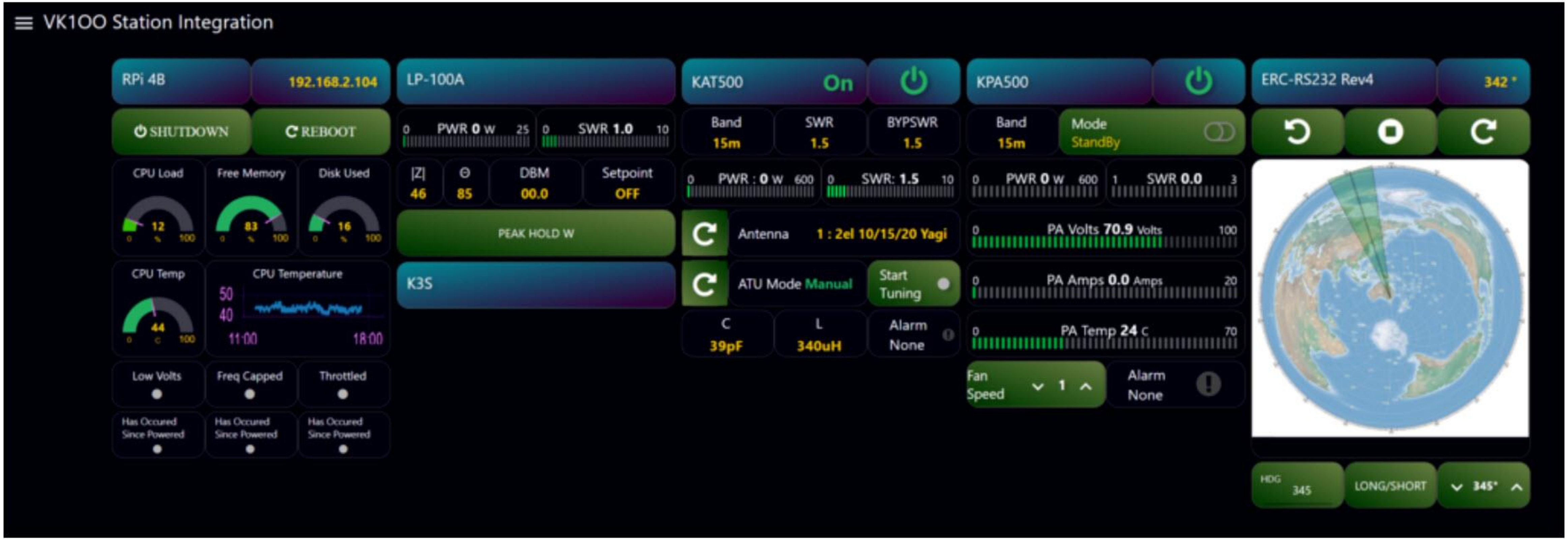
Tx Message
KI7SKT W8BE FM19

Special Op Mode
NONE

Ham Shack Dashboards (W2OZ)



Ham Shack Dashboards (VK1OO)



VK1OO Station Integration

RPi 4B 192.168.2.104

SHUTDOWN REBOOT

CPU Load 12 % · Free Memory 83 % · Disk Used 16 %

CPU Temp 44 C

CPU Temperature

Low Volts · Freq Capped · Throttled

Has Occured Since Powered · Has Occured Since Powered · Has Occured Since Powered

LP-100A

PWR 0 W · SWR 1.0

|Z| 46 · Θ 85 · DBM 00.0 · Setpoint OFF

PEAK HOLD W

K3S

KAT500 On

Band 15m · SWR 1.5 · BYPSWR 1.5

PWR : 0 W · SWR: 1.5

Antenna 1 : 2el 10/15/20 Yagi

ATU Mode Manual · Start Tuning

C 39pF · L 340uH · Alarm None

KPA500

Band 15m · Mode StandBy

PWR 0 W · SWR 0.0

PA Volts 70.9 Volts

PA Amps 0.0 Amps

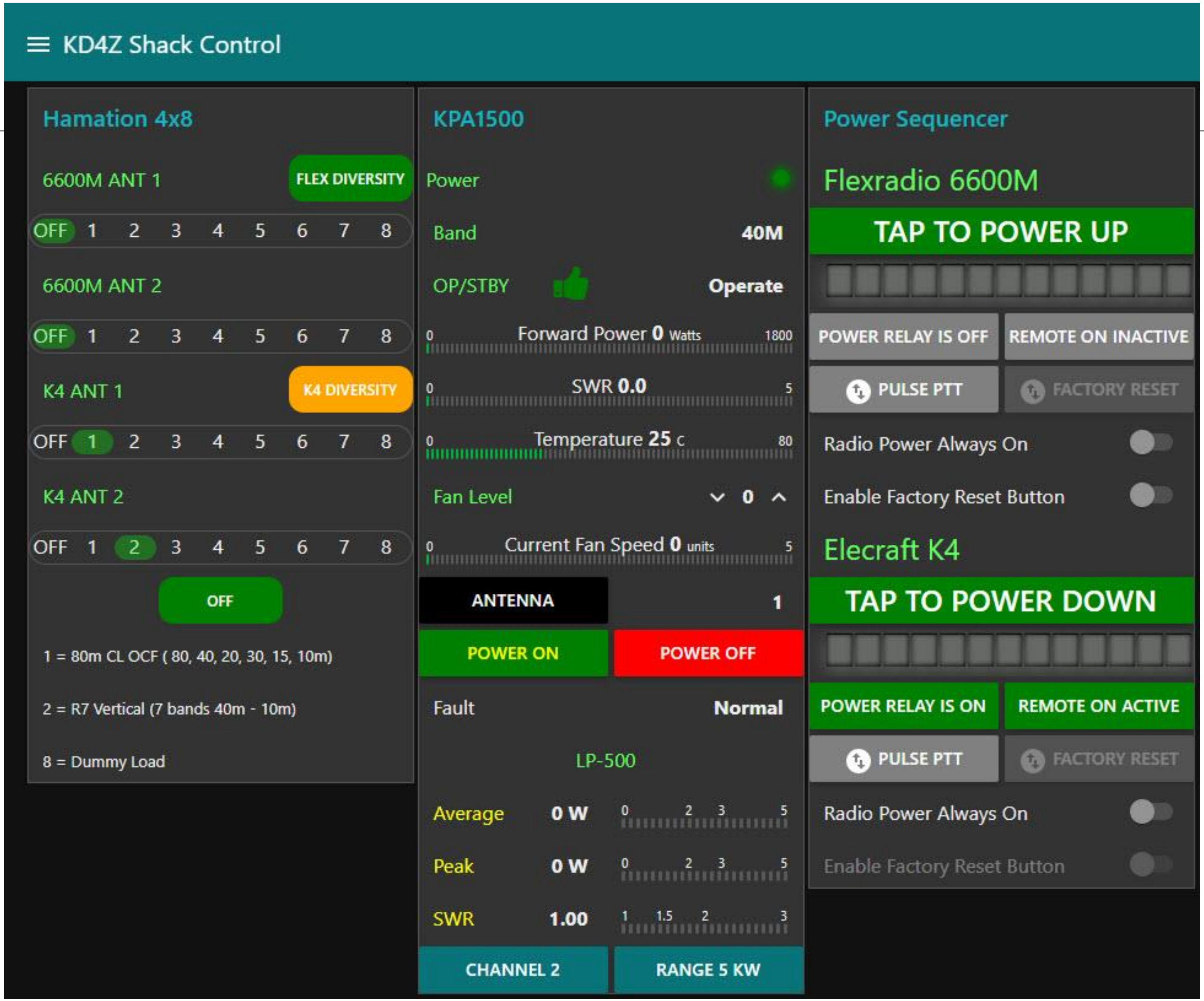
PA Temp 24 C

Fan Speed 1 · Alarm None

ERC-RS232 Rev4 342 °

HDG 345 · LONG/SHORT · 345°

Ham Shack Dashboards (KD4Z)



☰ KD4Z Shack Control

Hamation 4x8

6600M ANT 1 — FLEX DIVERSITY

[✓ OFF] 1 2 3 4 5 6 7 8

6600M ANT 2

[✓ OFF] 1 2 3 4 5 6 7 8

K4 ANT 1 — K4 DIVERSITY

OFF [✓ 1] 2 3 4 5 6 7 8

K4 ANT 2

OFF 1 [✓ 2] 3 4 5 6 7 8

OFF

1 = 80m CL OCF (80, 40, 20, 30, 15, 10m)

2 = R7 Vertical (7 bands 40m - 10m)

8 = Dummy Load

KPA1500

Power ●

Band 40M

OP/STBY Operate

Forward Power 0 Watts (0–1800)

SWR 0.0 (0–5)

Temperature 25 c (0–80)

Fan Level ⌄ 0 ⌃

Current Fan Speed 0 units (0–5)

ANTENNA 1

POWER ON | POWER OFF

Fault Normal

LP-500

Average 0 W

Peak 0 W

SWR 1.00

CHANNEL 2 | RANGE 5 KW

Power Sequencer

Flexradio 6600M

TAP TO POWER UP

POWER RELAY IS OFF | REMOTE ON INACTIVE

PULSE PTT | FACTORY RESET

Radio Power Always On ○

Enable Factory Reset Button ○

Elecraft K4

TAP TO POWER DOWN

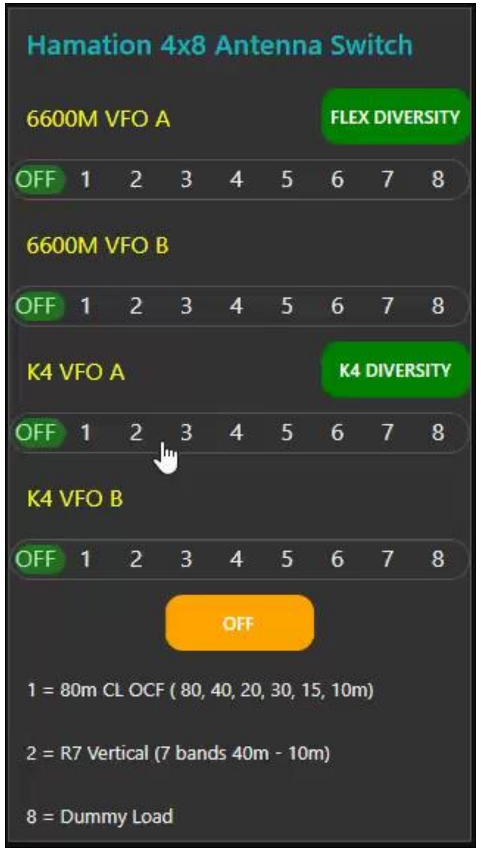
POWER RELAY IS ON | REMOTE ON ACTIVE

PULSE PTT | FACTORY RESET

Radio Power Always On ○

Enable Factory Reset Button ○

Example use of the Hamation Shacklan 4x8 Antenna Switch Selector from the Dashboard



Hamation 4x8 Antenna Switch

6600M VFO A — FLEX DIVERSITY

OFF 1 2 3 4 5 6 7 8

6600M VFO B

OFF 1 2 3 4 5 6 7 8

K4 VFO A — K4 DIVERSITY

OFF 1 2 3 4 5 6 7 8

K4 VFO B

OFF 1 2 3 4 5 6 7 8

OFF

1 = 80m CL OCF (80, 40, 20, 30, 15, 10m)

2 = R7 Vertical (7 bands 40m - 10m)

8 = Dummy Load

Click picture to play video

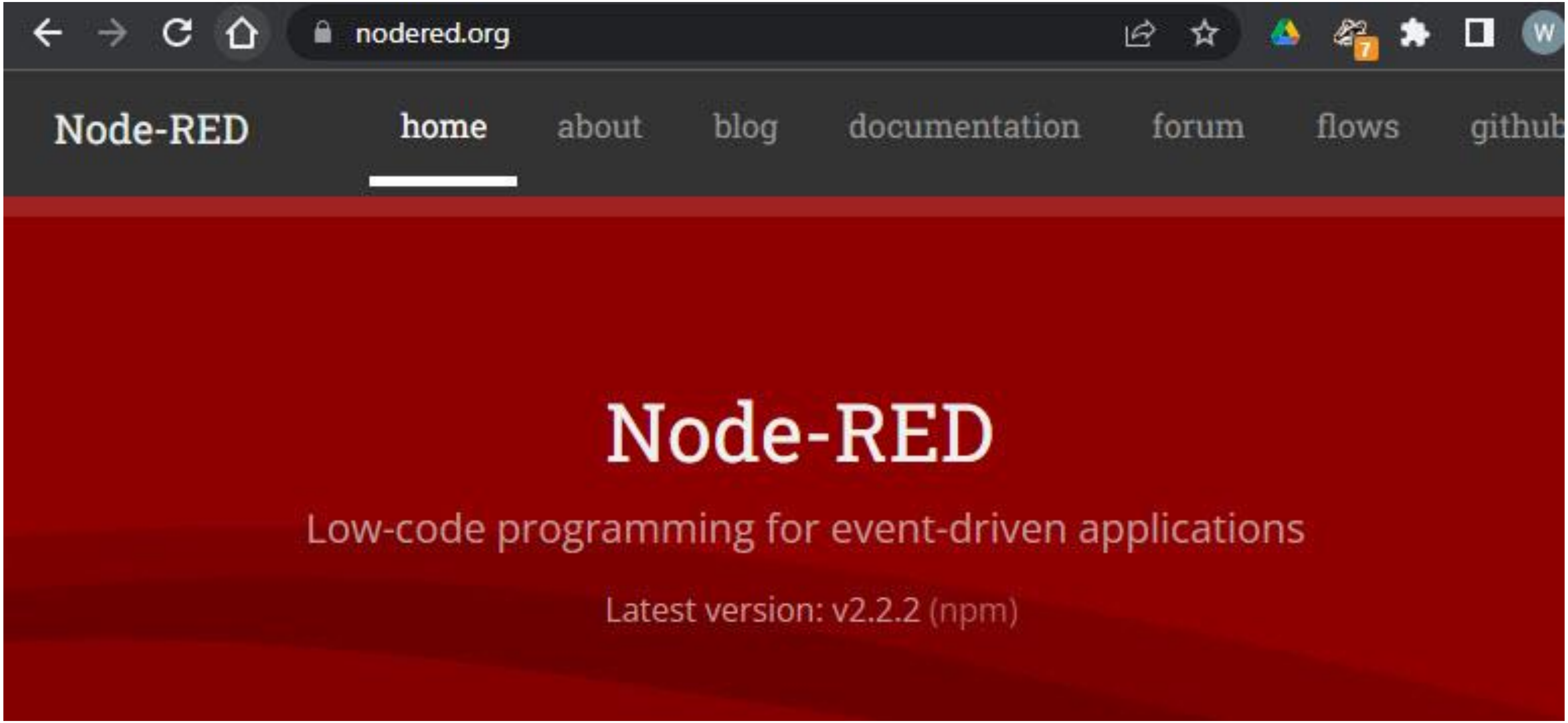
Shameless Plug: Requires ZBOX controller from KD4Z

Where to get started?

THE INTERNET OF COURSE

Node-RED

Start here: nodered.org



nodered.org

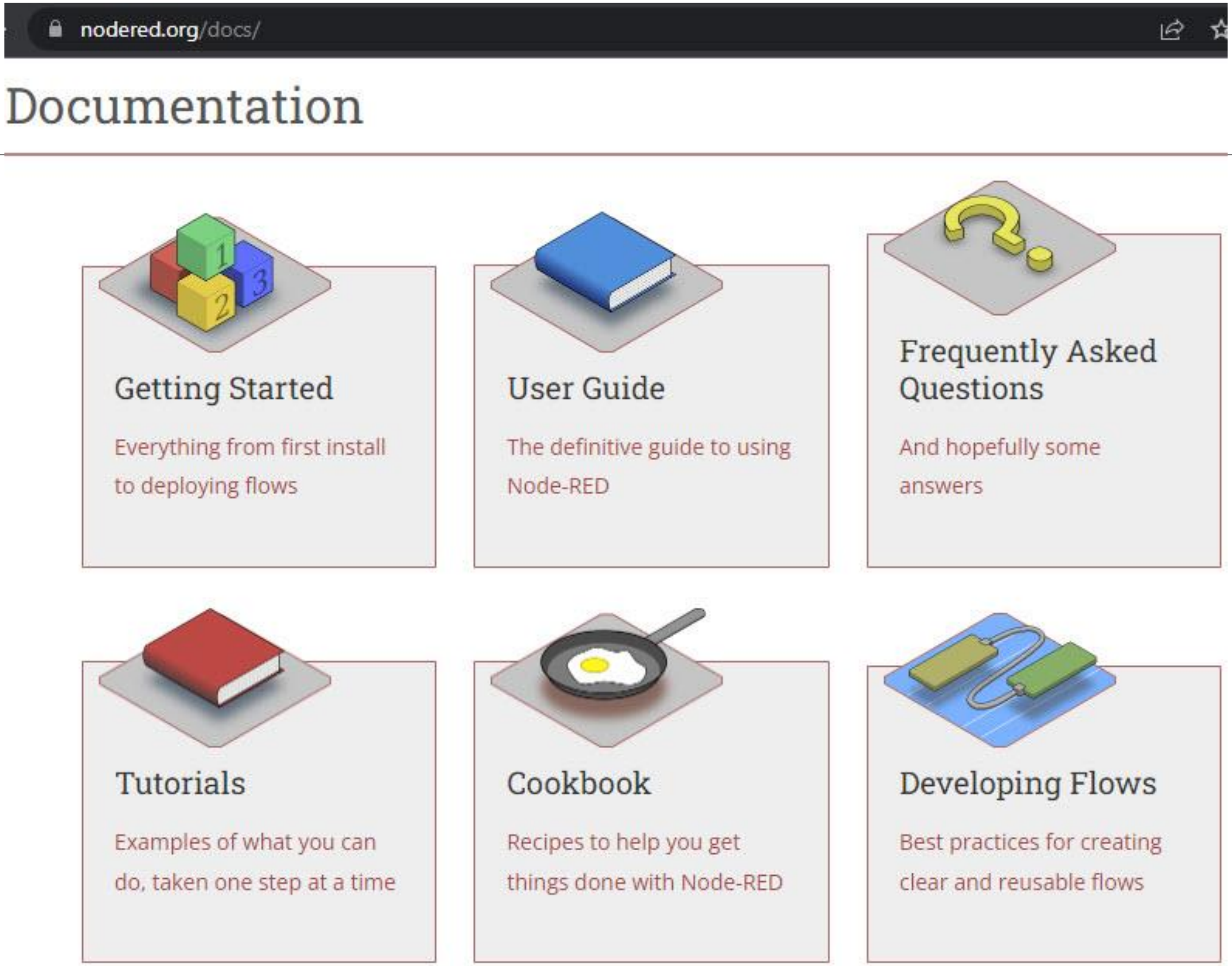
Node-RED home about blog documentation forum flows githu

Node-RED

Low-code programming for event-driven applications

Latest version: v2.2.2 (npm)

Documents: nodered.org/docs



nodered.org/docs/

Documentation

Getting Started

Everything from first install to deploying flows

User Guide

The definitive guide to using Node-RED

Frequently Asked Questions

And hopefully some answers

Tutorials

Examples of what you can do, taken one step at a time

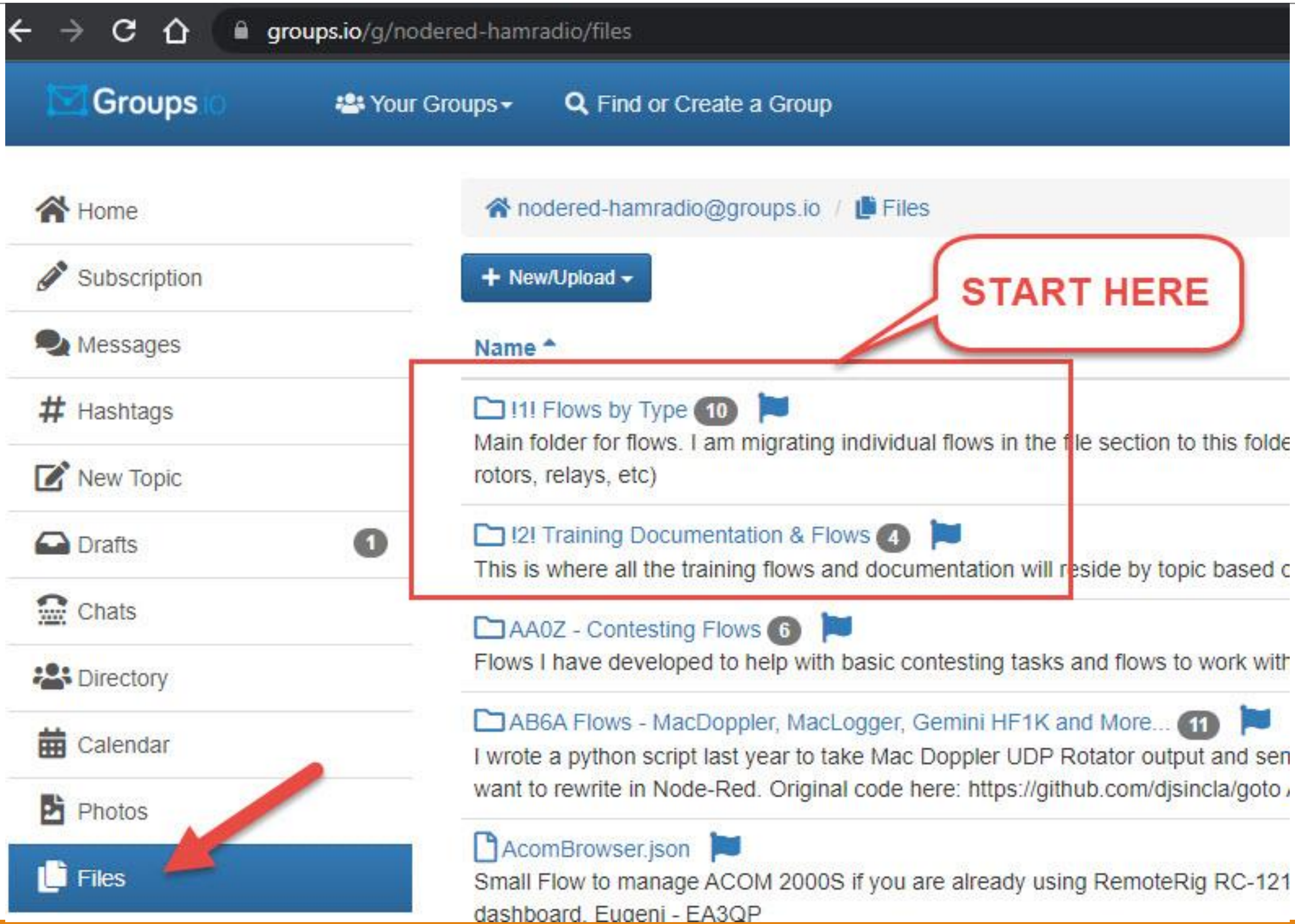
Cookbook

Recipes to help you get things done with Node-RED

Developing Flows

Best practices for creating clear and reusable flows

Join nodered-hamradio on groups.io



groups.io/g/nodered-hamradio/files

START HERE

!1! Flows by Type 10

Main folder for flows. I am migrating individual flows in the file section to this folde rotors, relays, etc)

!2! Training Documentation & Flows 4

This is where all the training flows and documentation will reside by topic based c

AA0Z - Contesting Flows 6

Flows I have developed to help with basic contesting tasks and flows to work with

AB6A Flows - MacDoppler, MacLogger, Gemini HF1K and More... 11

I wrote a python script last year to take Mac Doppler UDP Rotator output and sen want to rewrite in Node-Red. Original code here: https://github.com/djsincla/goto

AcomBrowser.json

Small Flow to manage ACOM 2000S if you are already using RemoteRig RC-121 dashboard. Eugeni - EA3QP

Other resources

Be sure to watch all of the videos on the Node-RED YouTube channel

Steve's Node Red Guide – http://stevesnoderedguide.com - A well done collection of instructional videos on Node-RED.

Nodered-hamradio list on groups.io – http://groups.io/g/nodered-hamradio
A very active email reflector focused on ham radio use of Node-RED. Files area is full of Flows that cover all aspects of ham shack automation including radios, rotors, antenna selectors, and power switches. Installation documents too.

And always, use your favorite search engine or YouTube to search for specific things you get stuck on.

Question / Answer

This slide deck accompanied a presentation to the North Fulton Amateur Radio League on April 19, 2022.

Links to the video recording of this presentation and a PDF version of this slide deck are available here: NFARL Club Meetings

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