

A wide-angle photograph of a university campus. In the foreground, a large, dark green evergreen tree stands on the left. A group of students is playing soccer on a green lawn in the middle ground. In the background, there are several modern university buildings with white and blue facades. The sky is blue with scattered white clouds. A large white 'X' is superimposed over the center of the image.

Internship

Université de Bordeaux



# Content

1. The team
2. Our vision
3. What we used
4. How we did it
5. Problems
6. Exhibits

Mesh Network of Environmental Sensors

# Our Team



**Jeroen Weber**



**Lian Aarts**

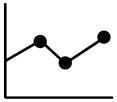


# Our vision



## Temperature and air quality

Measure environmental data



## Visualisation

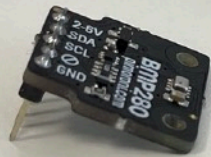
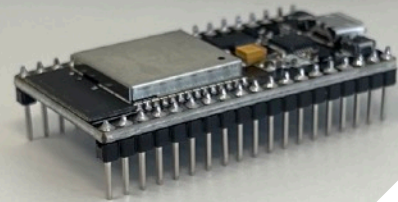
Visualise everything in Home Assistant



## Alerts

Send alerts when windows are left open





# What we used

- **Esp-32**
  - Read sensors
  - Mesh network
- **Home Assistant**
  - Visualisation
  - Managing mesh

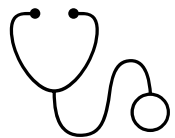
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# What is a mesh network



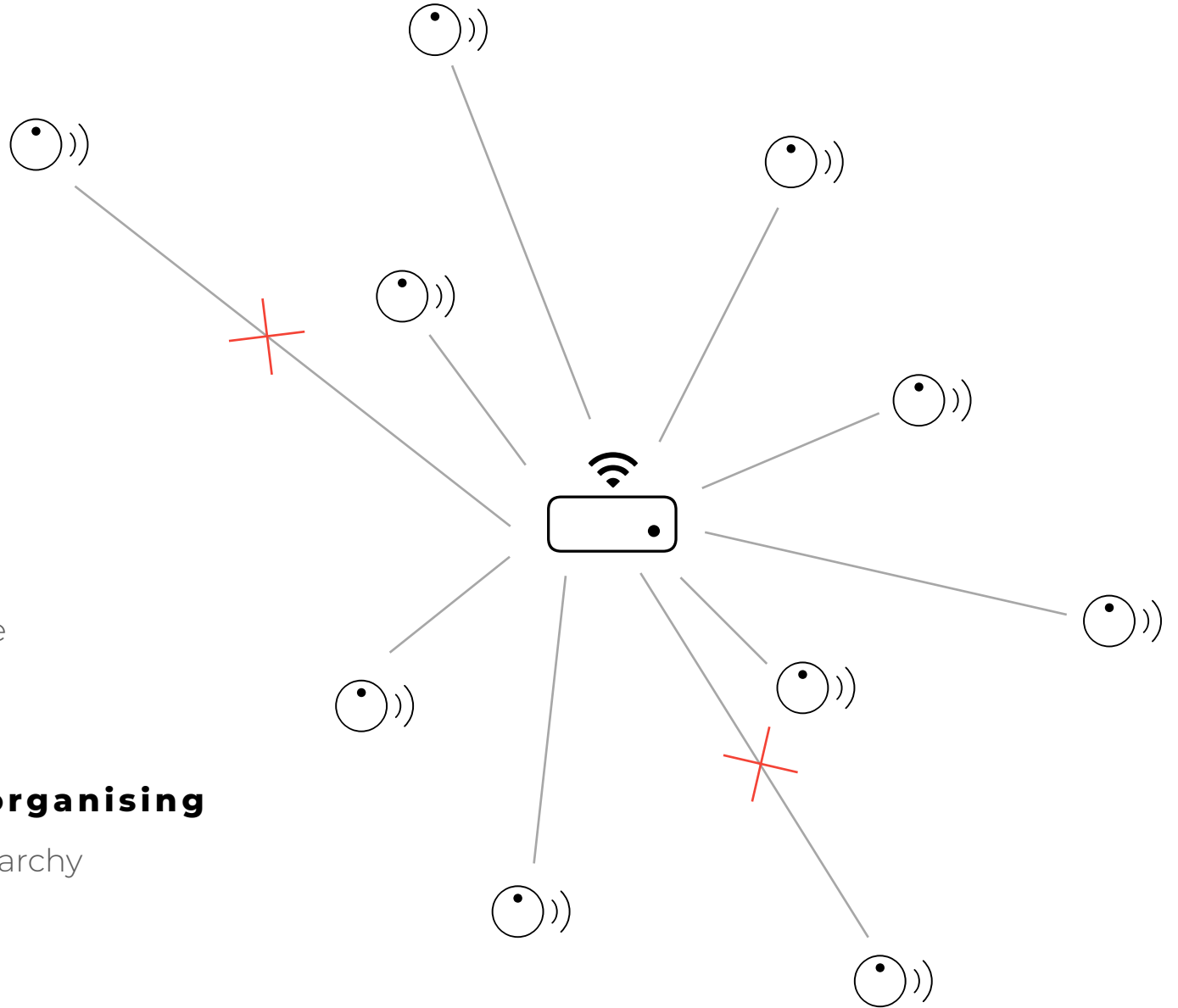
## **Easier to deploy**

With no existing infrastructure



## **Self-healing and self-organising**

Doesn't rely on traditional hierarchy



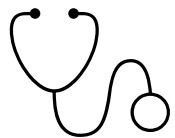
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# What is a mesh network



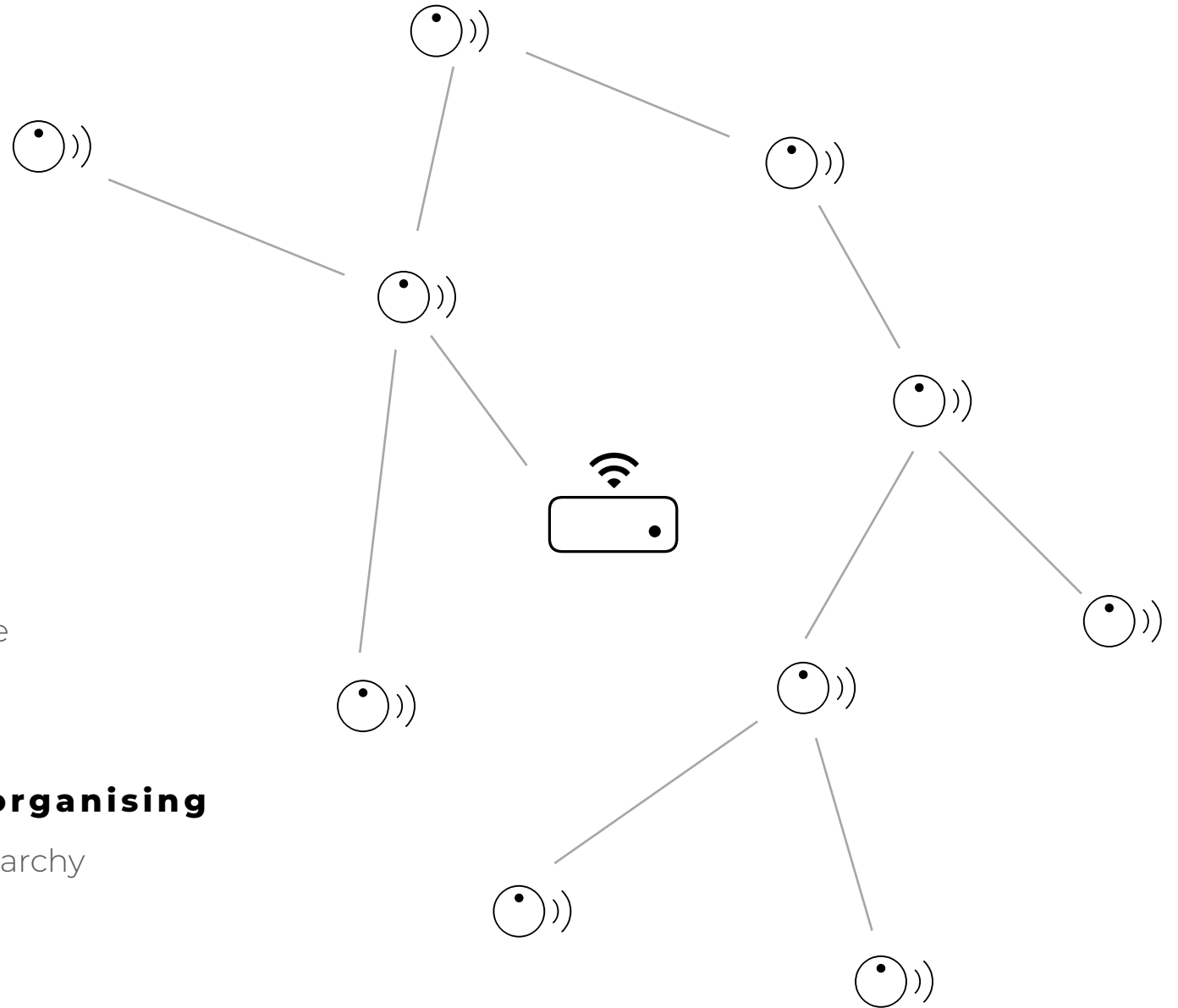
## **Easier to deploy**

With no existing infrastructure



## **Self-healing and self-organising**

Doesn't rely on traditional hierarchy





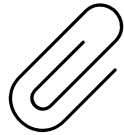
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## What is Home Assistant

- Local
- Open-source
- Home automation
- Sensors and actors



# How we did it



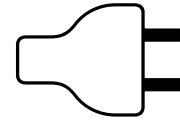
## **Sensor research**

Ease of use  
Accuracy  
Support



## **Mesh network**

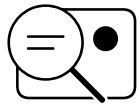
Root selection  
SDK  
MQTT/API



## **Home Assistant**

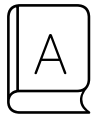
Visualisation  
Add-on  
Notifications

# Sensor research



## Research paper

Comparison of the sensors



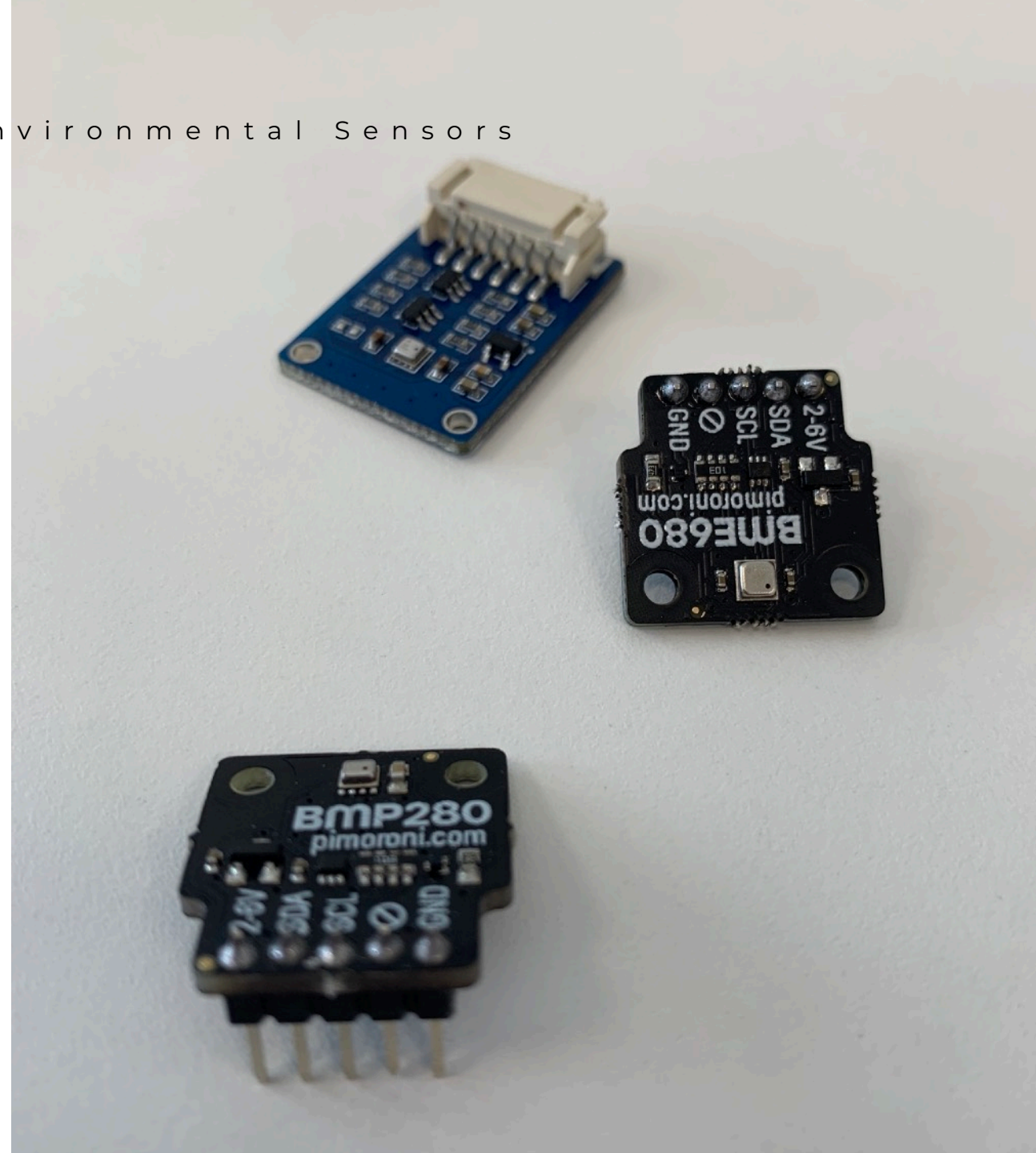
## Library

Reading the sensor data



## Selected sensor

We chose to use the BME680







# Mesh network

## Setup

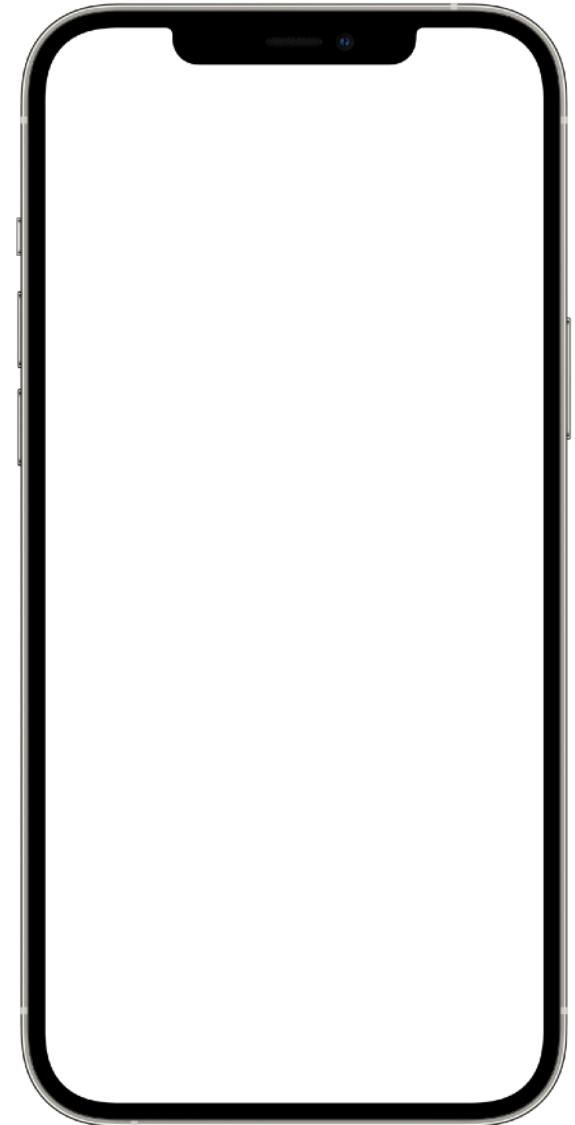
- Setup via AP
- Saved in EEPROM

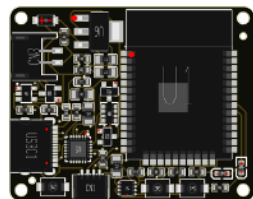
## Root selection

- Best connection to HA
- Self-healing
- Api POST

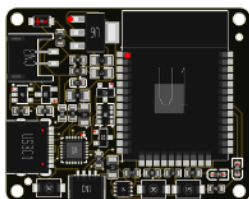
## Messaging

- JSON format based on SenML
- At set intervals

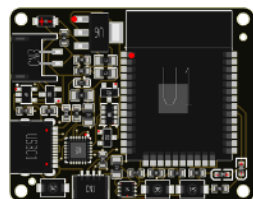




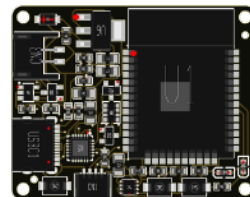
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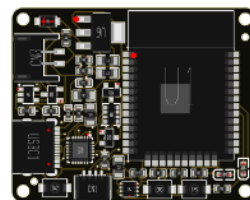
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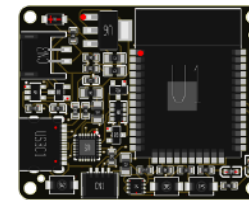
Node 3



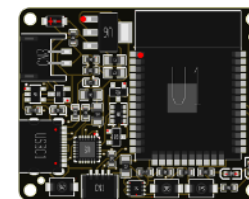
Node 3



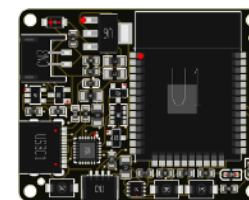
Node 4



Node 5



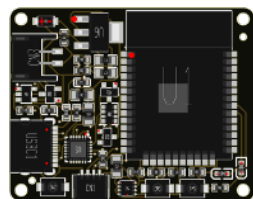
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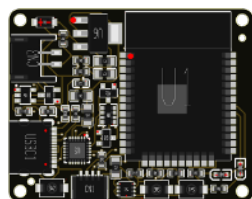
Node 7

Access point range

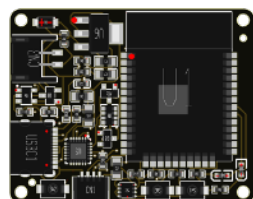




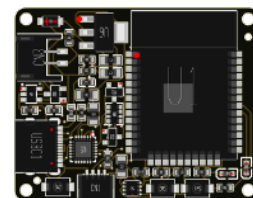
Node 1  
RSSI: -56



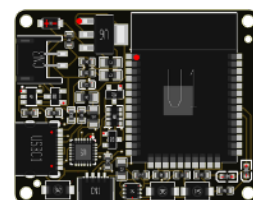
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RSSI: -38



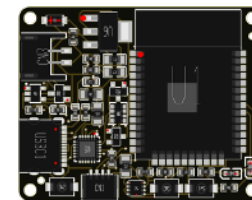
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RSSI: -42



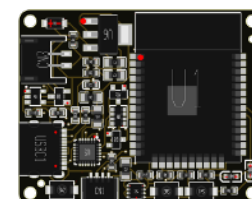
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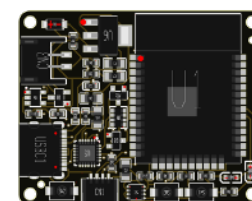
Node 4



Node 5

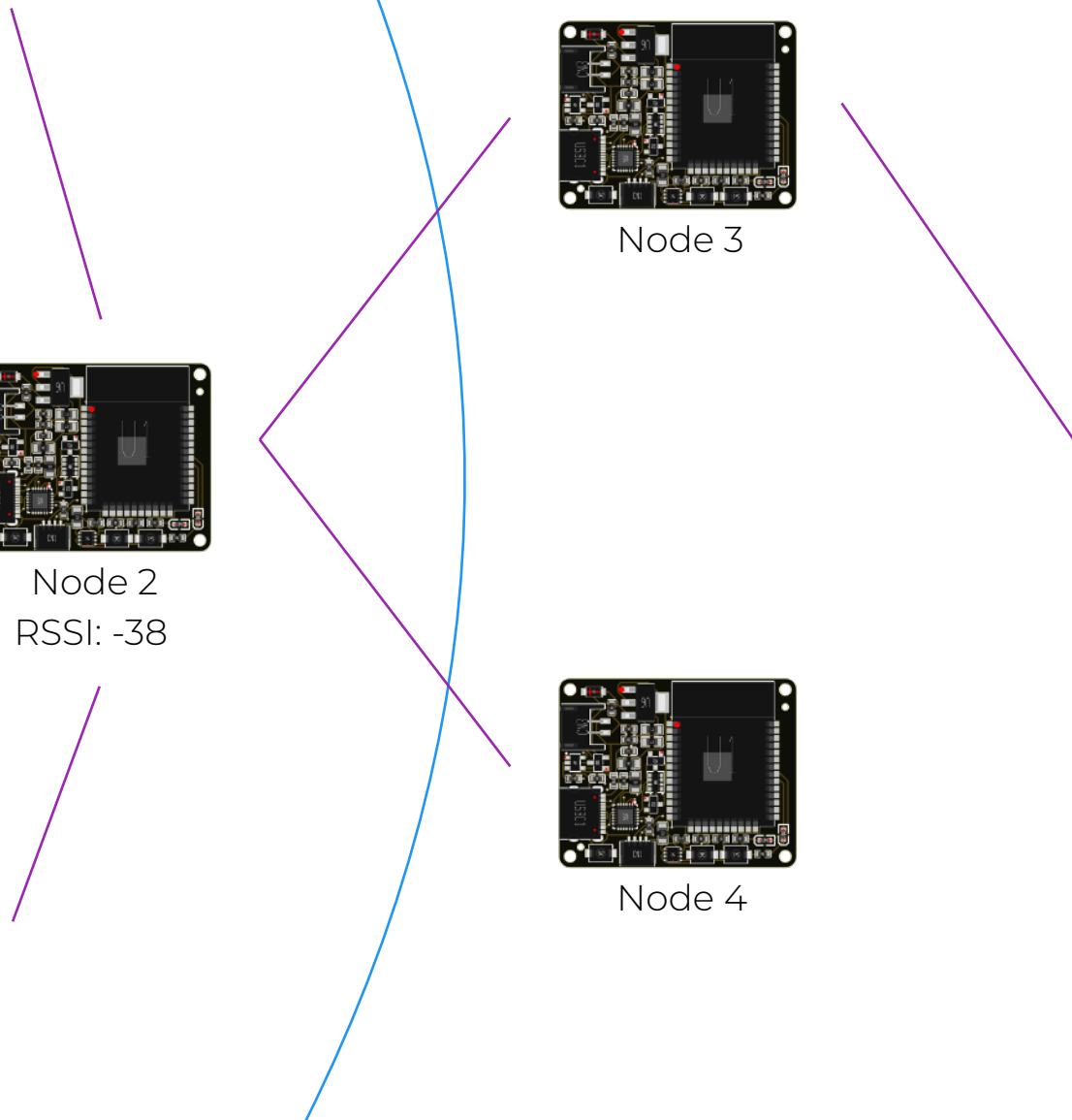


Node 6

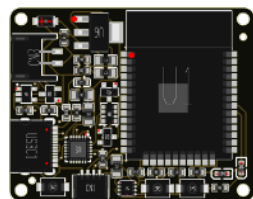


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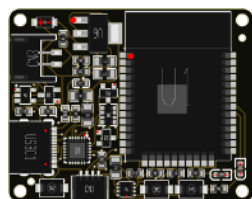
Access point range



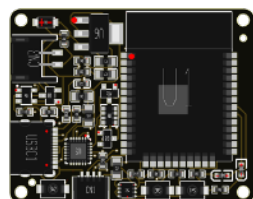




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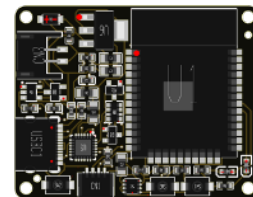


Node 2  
RSSI: -38

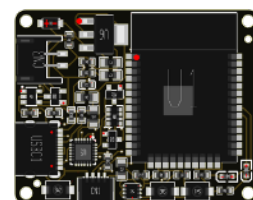


Node 3  
RSSI: -42

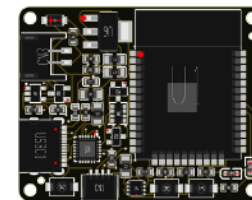
Access point range



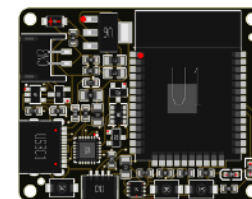
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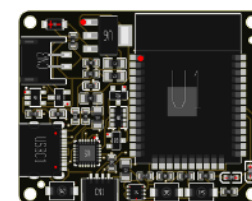
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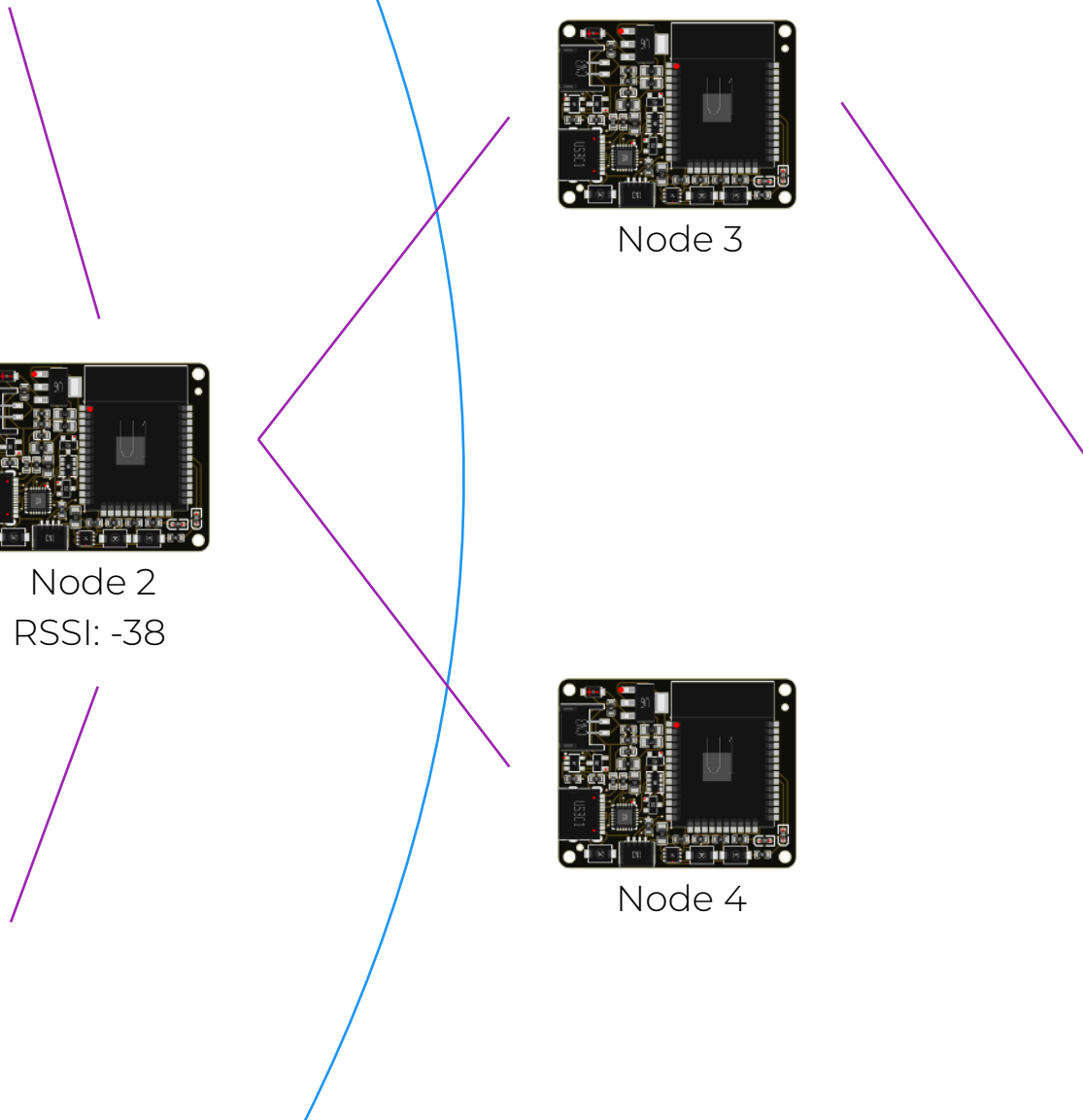
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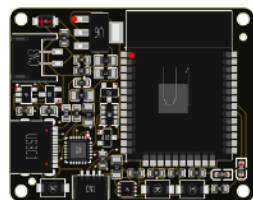


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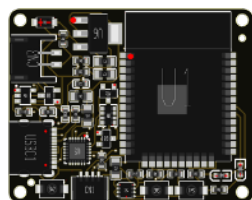


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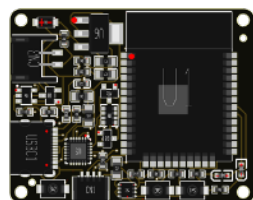




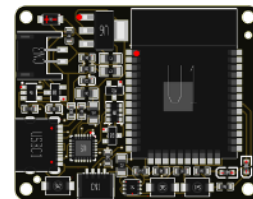
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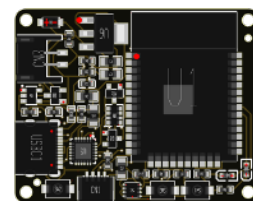
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RSSI: -38



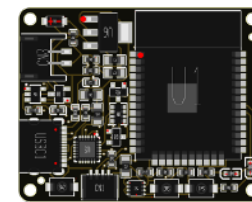
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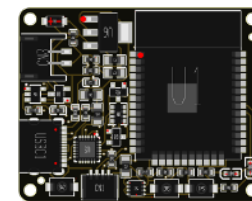
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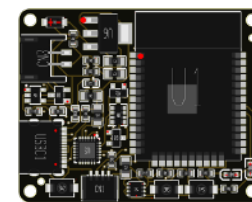
Node 4



Node 5

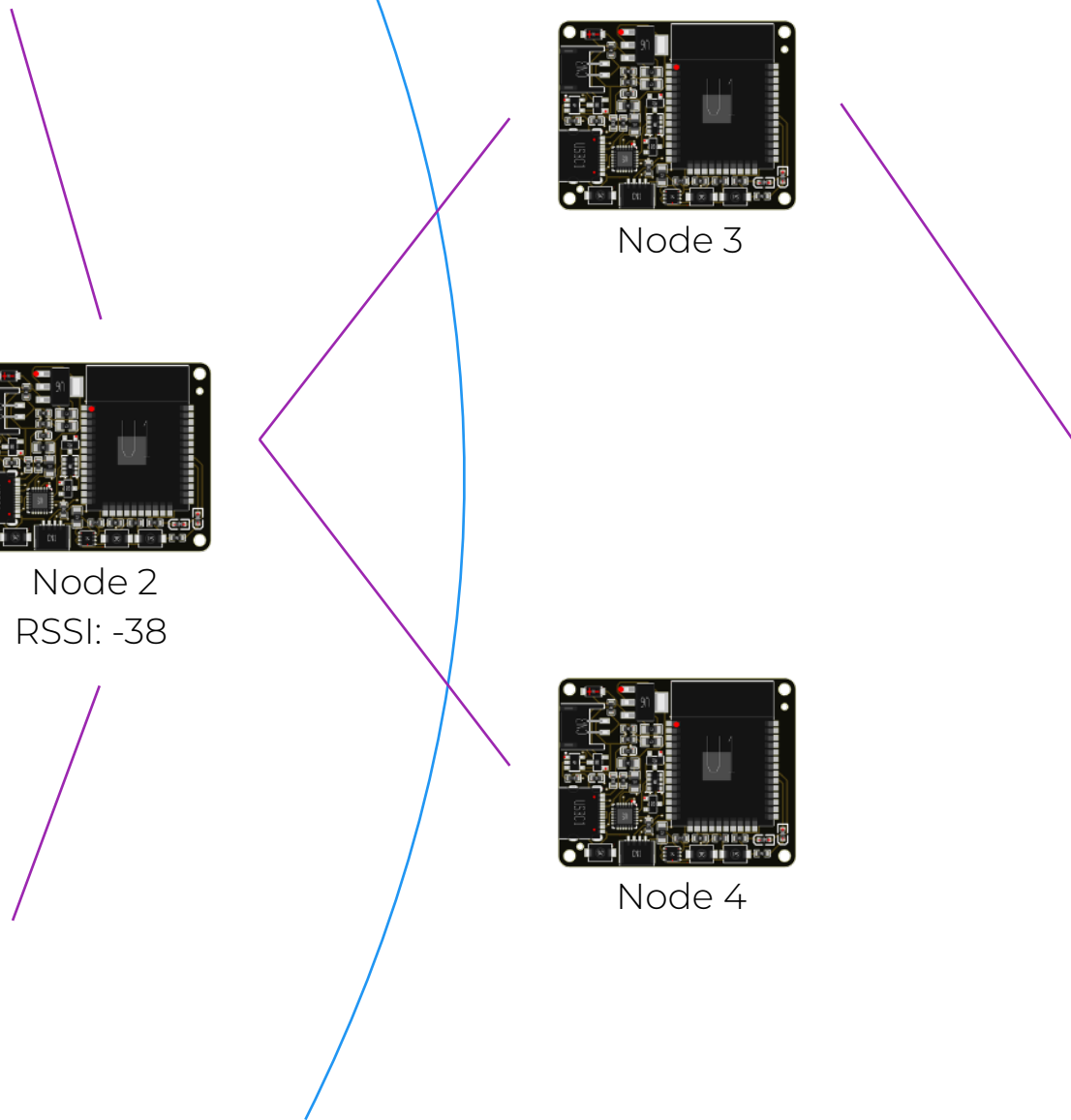


Node 6



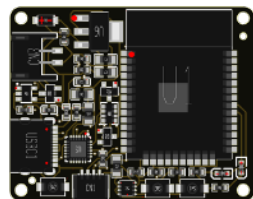
Node 7

Access point range

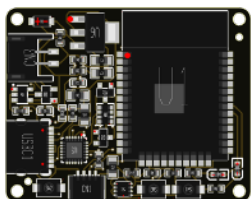




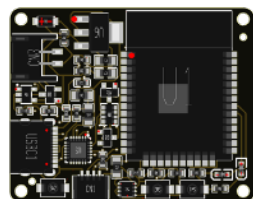
API



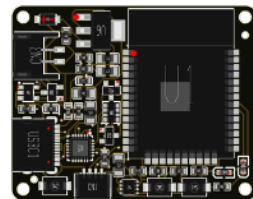
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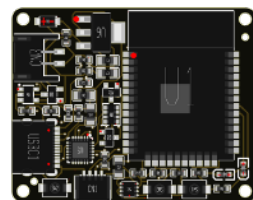
Node 2  
Root Node



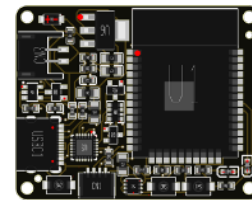
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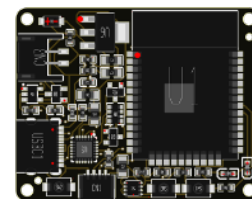
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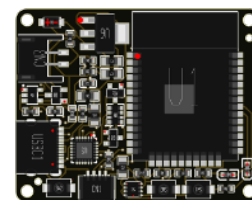
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Node 5

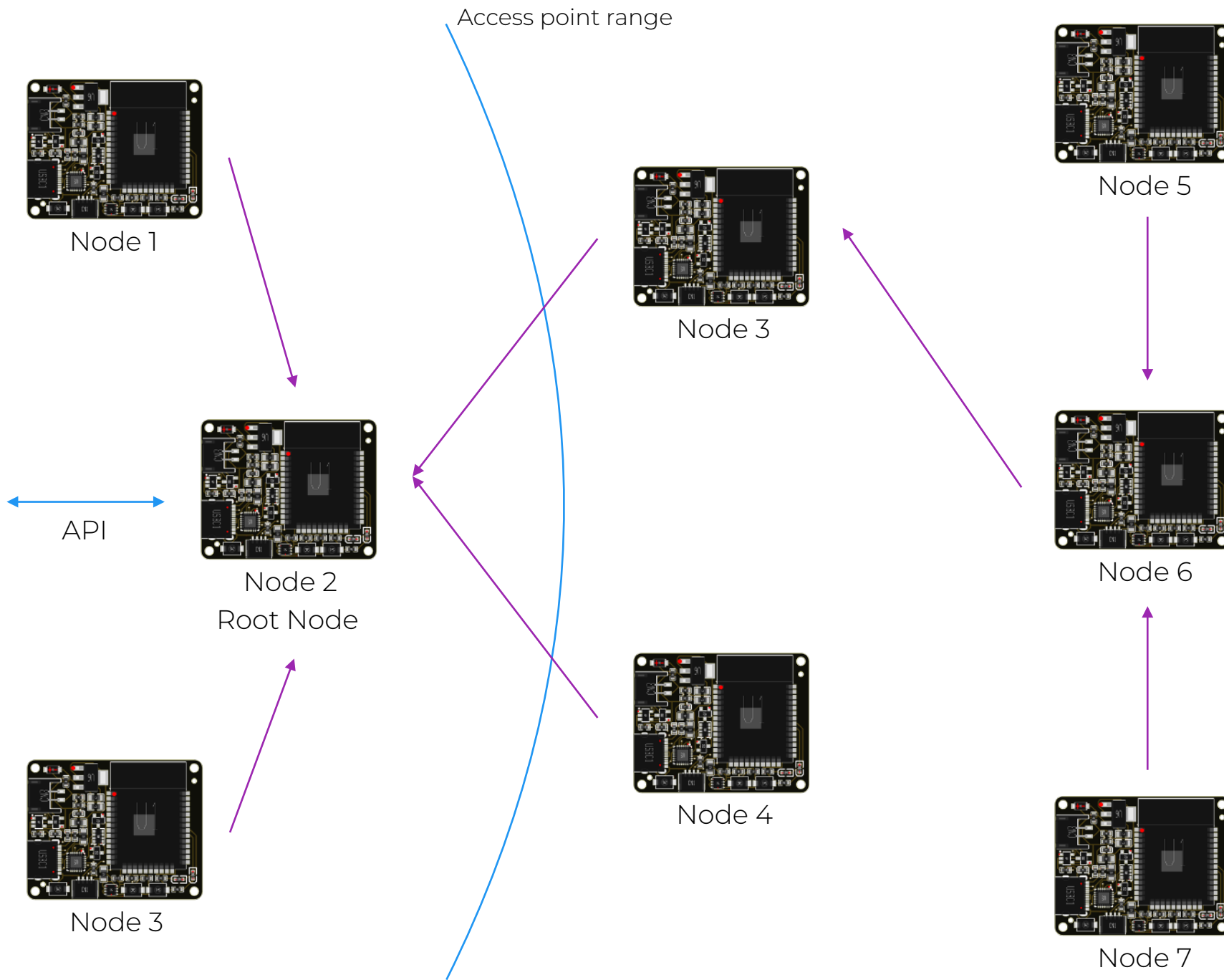


Node 6



Node 7

Access point range





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# Home Assistant

## Supervised install

- Debian Buster
- Instruction manual

## Access point

- For mesh network
- Isolated from external users

## Alerts

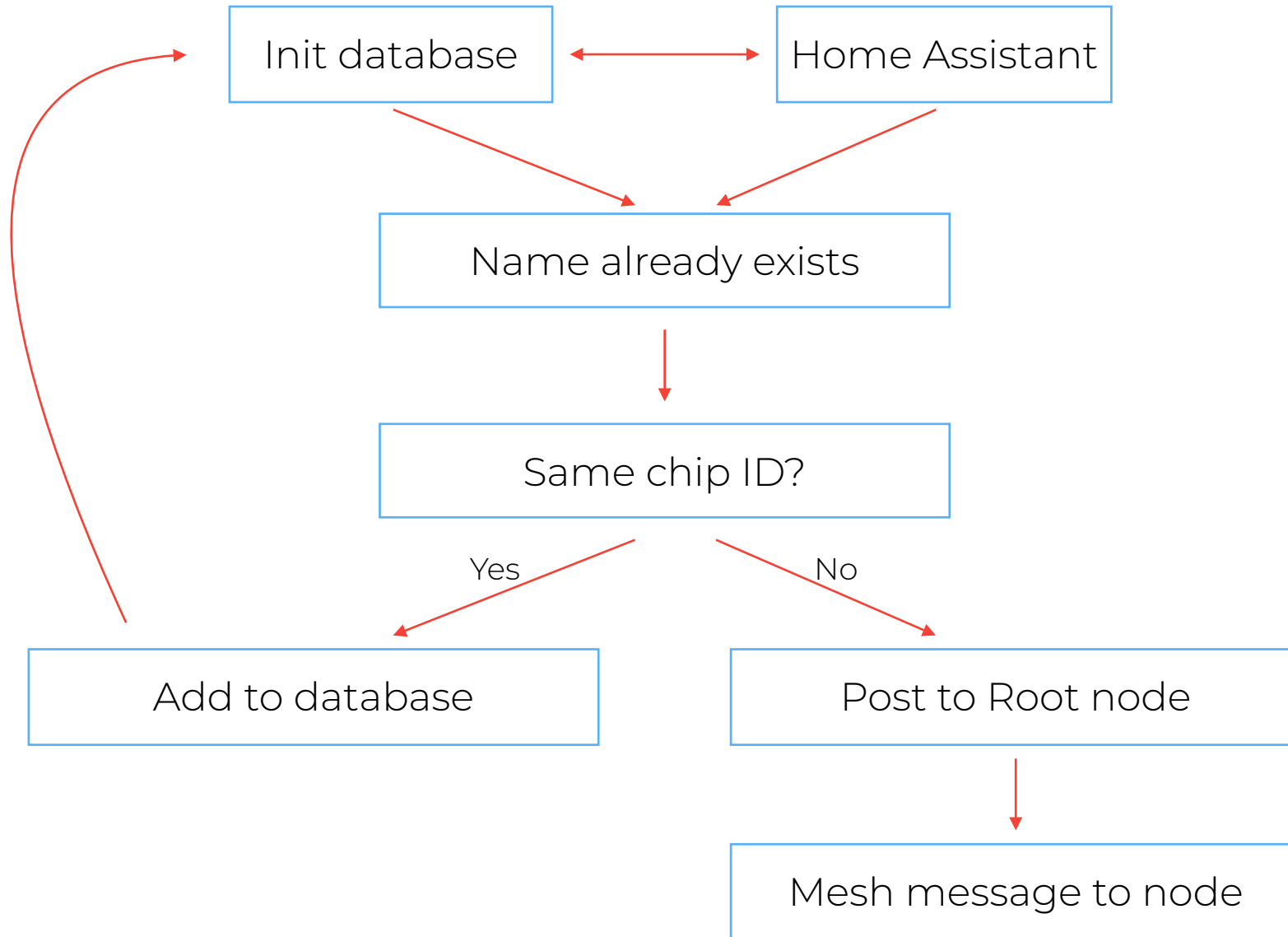
- Push notifications

## Add-on

- Id checking

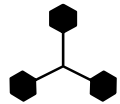


# Name check add-on



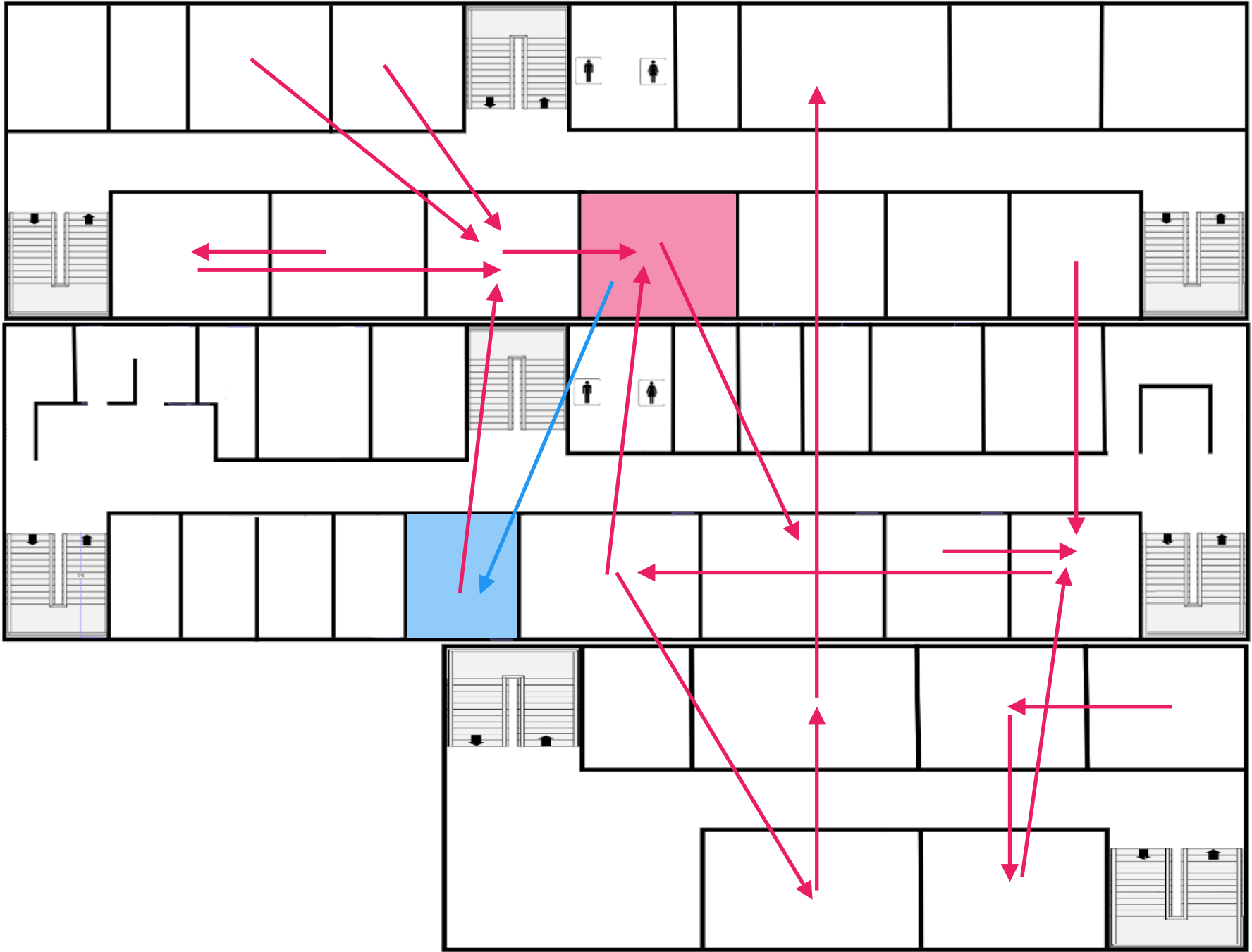
## Mesh Network of Environmental Sensors

# Large scale experiment



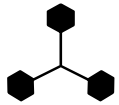
**Successful test with 20+ sensors**

<div>001</div> <div><div><div>001 temperature</div><div>21.61 °C</div></div><div><div>001 humidity</div><div>51.56 %</div></div><div><div>001 pressure</div><div>1,011.45 Hpa</div></div><div><div>001 gas</div><div>396.17 ohm</div></div><div><div>001 chipid</div><div>629,348,013 ID</div></div></div>	<div>002</div> <div><div><div>002 temperature</div><div>21.61 °C</div></div><div><div>002 humidity</div><div>49.58 %</div></div><div><div>002 pressure</div><div>1,011.12 Hpa</div></div><div><div>002 gas</div><div>214.45 ohm</div></div><div><div>002 chipid</div><div>1,830,353,413 ID</div></div></div>	<div>003</div> <div><div><div>003 temperature</div><div>22.07 °C</div></div><div><div>003 humidity</div><div>49.7 %</div></div><div><div>003 pressure</div><div>1,010.8 Hpa</div></div><div><div>003 gas</div><div>251.22 ohm</div></div><div><div>003 chipid</div><div>1,830,352,741 ID</div></div></div>	<div>004</div> <div><div><div>004 temperature</div><div>20.98 °C</div></div><div><div>004 humidity</div><div>52.56 %</div></div><div><div>004 pressure</div><div>1,010.77 Hpa</div></div><div><div>004 gas</div><div>302.87 ohm</div></div><div><div>004 chipid</div><div>1,830,333,933 ID</div></div></div>	<div>006</div> <div><div><div>006 temperature</div><div>20.6 °C</div></div><div><div>006 humidity</div><div>54.17 %</div></div><div><div>006 pressure</div><div>1,010.9 Hpa</div></div><div><div>006 gas</div><div>286.42 ohm</div></div><div><div>006 chipid</div><div>629,348,241 ID</div></div></div>
<div>101</div> <div><div><div>101 temperature</div><div>23.11 °C</div></div><div><div>101 humidity</div><div>43.18 %</div></div><div><div>101 pressure</div><div>1,010.85 Hpa</div></div><div><div>101 gas</div><div>1,780.02 ohm</div></div><div><div>101 chipid</div><div>1,830,308,113 ID</div></div></div>	<div>103</div> <div><div><div>103 temperature</div><div>23.61 °C</div></div><div><div>103 humidity</div><div>43.07 %</div></div><div><div>103 pressure</div><div>1,011.3 Hpa</div></div><div><div>103 gas</div><div>537.11 ohm</div></div><div><div>103 chipid</div><div>1,830,304,465 ID</div></div></div>	<div>105</div> <div><div><div>105 temperature</div><div>21.61 °C</div></div><div><div>105 humidity</div><div>53.78 %</div></div><div><div>105 pressure</div><div>1,010.19 Hpa</div></div><div><div>105 gas</div><div>411.76 ohm</div></div><div><div>105 chipid</div><div>1,830,292,809 ID</div></div></div>	<div>107</div> <div><div><div>107 temperature</div><div>21.78 °C</div></div><div><div>107 humidity</div><div>51.33 %</div></div><div><div>107 pressure</div><div>1,010.81 Hpa</div></div><div><div>107 gas</div><div>250.59 ohm</div></div><div><div>107 chipid</div><div>629,349,673 ID</div></div></div>	<div>109</div> <div><div><div>109 temperature</div><div>24.54 °C</div></div><div><div>109 humidity</div><div>43.29 %</div></div><div><div>109 pressure</div><div>1,010.5 Hpa</div></div><div><div>109 gas</div><div>1,418.78 ohm</div></div><div><div>109 chipid</div><div>1,830,354,089 ID</div></div></div>
<div>201</div> <div><div><div>201 temperature</div><div>20.47 °C</div></div><div><div>201 humidity</div><div>57.36 %</div></div><div><div>201 pressure</div><div>1,009.92 Hpa</div></div><div><div>201 gas</div><div>187.98 ohm</div></div><div><div>201 chipid</div><div>1,830,354,881 ID</div></div></div>	<div>206</div> <div><div><div>206 temperature</div><div>21.4 °C</div></div><div><div>206 humidity</div><div>49.67 %</div></div><div><div>206 pressure</div><div>1,010.56 Hpa</div></div><div><div>206 gas</div><div>649.16 ohm</div></div><div><div>206 chipid</div><div>1,829,384,329 ID</div></div></div>	<div>207</div> <div><div><div>207 temperature</div><div>23.81 °C</div></div><div><div>207 humidity</div><div>44.51 %</div></div><div><div>207 pressure</div><div>1,010.35 Hpa</div></div><div><div>207 gas</div><div>685.65 ohm</div></div><div><div>207 chipid</div><div>1,830,304,877 ID</div></div></div>	<div>209</div> <div><div><div>209 temperature</div><div>21.37 °C</div></div><div><div>209 humidity</div><div>50.63 %</div></div><div><div>209 pressure</div><div>1,010.58 Hpa</div></div><div><div>209 gas</div><div>528.63 ohm</div></div><div><div>209 chipid</div><div>1,830,316,513 ID</div></div></div>	<div>210</div> <div><div><div>210 temperature</div><div>23.82 °C</div></div><div><div>210 humidity</div><div>45.88 %</div></div><div><div>210 pressure</div><div>1,010.33 Hpa</div></div><div><div>210 gas</div><div>406.29 ohm</div></div><div><div>210 chipid</div><div>1,830,331,873 ID</div></div></div>
<div>211</div> <div><div><div>211 temperature</div><div>24.35 °C</div></div><div><div>211 humidity</div><div>39.38 %</div></div><div><div>211 pressure</div><div>1,010.36 Hpa</div></div><div><div>211 gas</div><div>615.68 ohm</div></div><div><div>211 chipid</div><div>1,830,310,893 ID</div></div></div>	<div>212</div> <div><div><div>212 temperature</div><div>24.31 °C</div></div><div><div>212 humidity</div><div>43.74 %</div></div><div><div>212 pressure</div><div>1,010.45 Hpa</div></div><div><div>212 gas</div><div>2,522.55 ohm</div></div><div><div>212 chipid</div><div>629,350,177 ID</div></div></div>	<div>213</div> <div><div><div>213 temperature</div><div>23.58 °C</div></div><div><div>213 humidity</div><div>44.8 %</div></div><div><div>213 pressure</div><div>1,009.99 Hpa</div></div><div><div>213 gas</div><div>639.21 ohm</div></div><div><div>213 chipid</div><div>1,830,309,033 ID</div></div></div>		





# Problems we encountered



## **Painless mesh update**

Update that was not compatible with the wifi library



## **SMTP**

For sending mail notifications



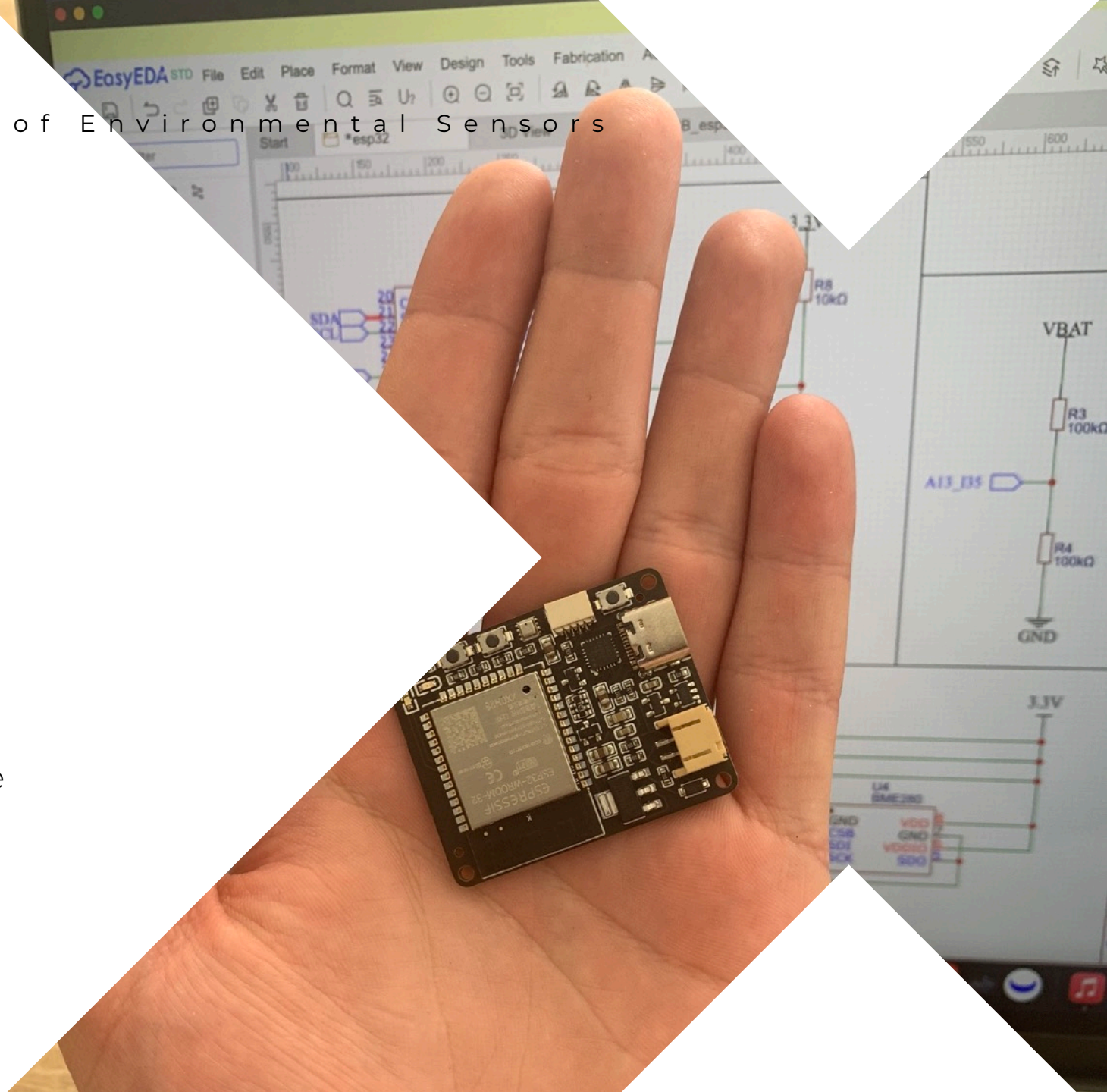
## **Cyber attack on school**

No access to Mattermost or GitLab



# Our exhibits

- **Sensor research**
  - PDF document
- **Documentation mesh**
  - Markdown language
  - General explanation
  - security
- **Tutorial Home Assistant**
  - Markdown
  - How to setup HA on a Linux machine
- **Doxygen**
  - Description of the code





Internship  
U - Bordeaux  
2021-2022



Thanks for listening!

If you have any questions feel free to ask!

