Airbox with Gemtek LoRa

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Outline

Airbox + LoRa	11 Bytes	MQTT	Project
What is airbox? How to use LoRa?	How to sent data?	How to get the data ?	Location Aware Sensing System

The Airbox

- **Realtime ambient sensing include -**
  - Temperature & Humidity
  - $PM_{2.5}$
- **Smart & Healthy city**
- **Environmental education**

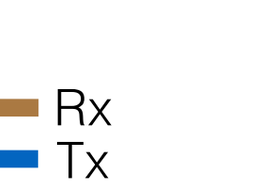
And now …Gemtek inside!

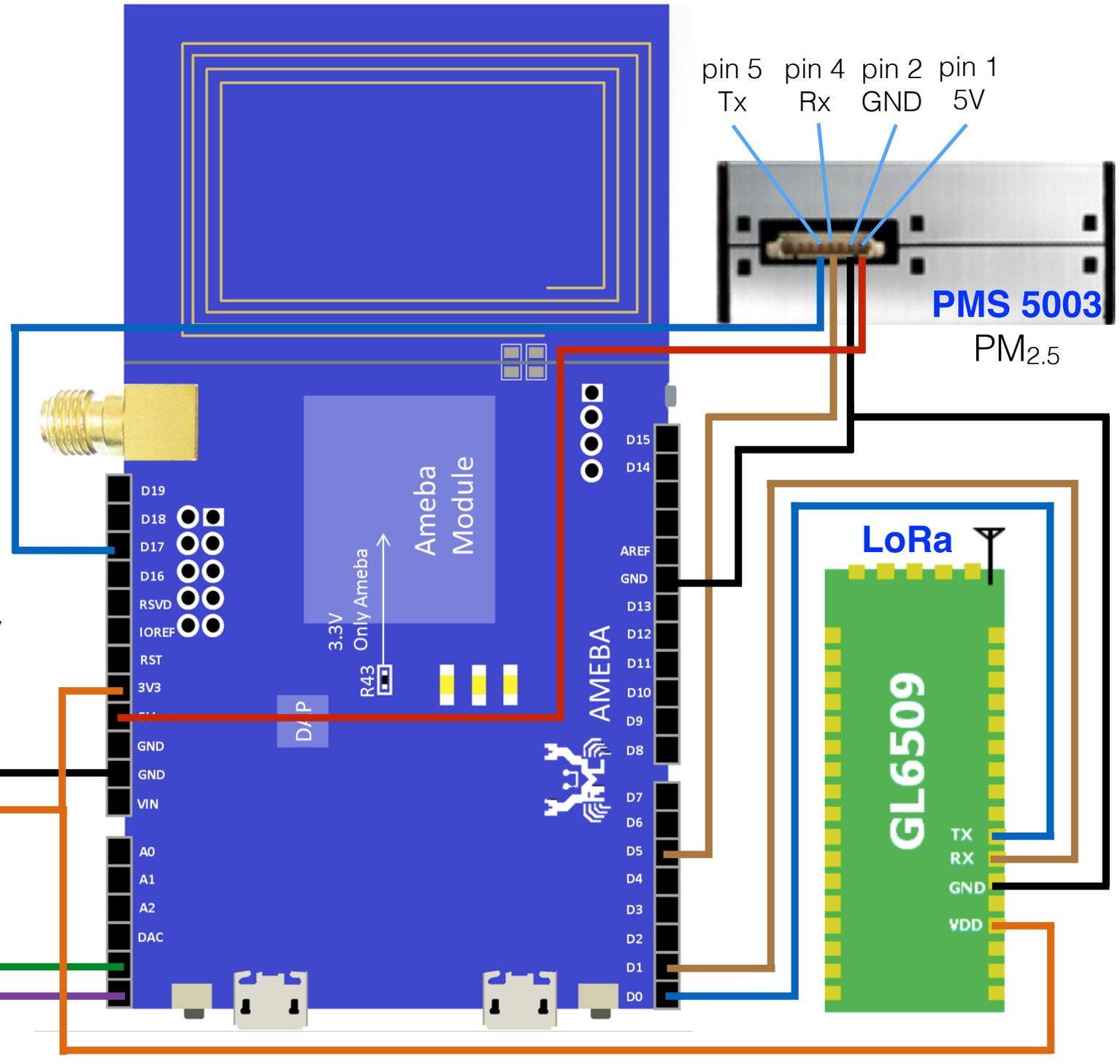
Airbox + LoRa

Rx
Tx
5v
3v3
SDA
SCL
GND

p.s Original temperature & humidity sensor is HTS221

SHT 31
Temperature & Humidity





11 Bytes

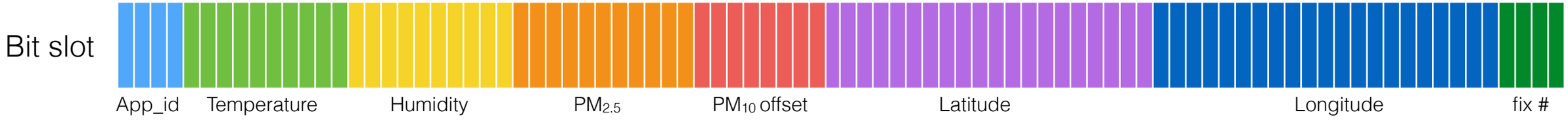
- **LoRa**
  - Long rage communication
  - Low bit rate connected object
  - Limited in 11 bytes

- **Our data**
  - Temperature & Humidity
  - $PM_{2.5}$ & PM_{10}
  - GPS
  - App ID

- **Bitwise operation**

11 Bytes

Transmit attribute	App_ID	(Temperature value + 20) x 10	Humidity value x 10	PM2.5	PM10 - PM2.5	Lat + 90	Lon + 180	fix/num
Bits #	4 bits	10 bits	10 bits	11 bits	8 bits	20 bits	21 bits	4 bits
Recording range	0~15	-20 ~ 82.3	0 ~ 102.3	0 ~ 2047	0 ~ 255	-90 ~ 90	-180 ~ 180	0 ~ 14
Transmit value	0~15	0 ~ 1023	0 ~ 1023	0 ~ 2047	0 ~ 255	D: 0 ~ 180 (8 bits) M: 0 ~ 59 (6 bits) S: 0 ~ 59 (6 bits)	D: 0 ~ 360 (9 bits) M: 0 ~ 59 (6 bits) S: 0 ~ 59 (6 bits)	0 ~ 15
P.S				PM10 = PM2.5 + (PM10 - PM2.5)		DMS format	DMS format	15: Fake GPS



Some variable

```
56 void LoRaBitMap(byte &app_id, float &temperature, float &humidity, \
57 int &pm25, int &pm100, char *gps_lat, char *gps_lon, int &fix_num){
58     word temperatureLora = (int)((temperature+20)*10);
59     word humiditylora = (int)(humidity*10);
60     word pm25lora = pm25;
61     byte pm100Offset = pm100 - pm25;
62     float gps_lat_f = (float)atof(gps_lat);
63     float gps_lon_f = (float)atof(gps_lon);
64     gps_lat_f += 90;
65     gps_lon_f += 180;
66     int gps_lat_i = (int) (gps_lat_f*10000);
67     int gps_lon_i = (int) (gps_lon_f*10000);
68     byte lat_D = (int) gps_lat_f;
69     float temp_lat_M = (gps_lat_f - lat_D)*100;
70     byte lat_M = (int) temp_lat_M;
71     byte lat_S = (int) gps_lat_i%100;
72     word lon_D = (int) gps_lon_f;
73     float temp_lon_M = (gps_lon_f - lon_D)*100;
74     byte lon_M = (int) temp_lon_M;
75     byte lon_S = (int) gps_lon_i%100;
76     byte gps_fix = fix_num;
77     char buff[150];
```

Bitwise operation

```
78      lora_trans[0] = (app_id << 4) | (temperatureLora >> 6);
79      lora_trans[1] = (temperatureLora << 2) | (humiditylora >> 8);
80      lora_trans[2] = humiditylora;
81          // END FOR THE APP_ID, TEMPERATURE AND HUMIDITY
82      lora_trans[3] =  pm25lora >> 3;
83      lora_trans[4] = (pm25lora << 5)|(pm1000ffset >> 3);
84          // END FOR PM2.5
85      lora_trans[5] = (pm1000ffset <<5) | (lat_D >> 3);
86      lora_trans[6] = (lat_D << 5) | (lat_M >> 1);
87      lora_trans[7] = (lat_M << 7) | (lat_S << 1) | (lon_D >> 8);
88      lora_trans[8] = (byte)lon_D;
89      lora_trans[9] = (lon_M << 2) | (lon_S >> 4);
90      lora_trans[10] = (lon_S << 4) | gps_fix;
91          // END FOR PM10 AND GPS
```

Let’s go LoRa

AT command, launch your data!

↓

```
92    sprintf(buff, "AT+DTX=22,%02X%02X%02X%02X%02X%02X%02X%02X%02X%02X%02X\r\n", \
93    lora_trans[0], lora_trans[1], lora_trans[2], lora_trans[3], lora_trans[4], \
94    lora_trans[5], lora_trans[6], lora_trans[7], lora_trans[8], lora_trans[9], lora_trans[10]);
95    lora.print(buff);
```

Get the data

- **Prepare your MQTT info. (ex.)**
  - "host": "SERVER IP",
  - "port": 80,
  - "topic": "client/700000000/700000000-GIOT-MAKER",
  - "clientId": "700000000-generic-service",
  - "username": "700000000",
  - "password": “PASSWORD"
- **$ mosquitto_sub -h <Server_IP> -p 80 -t client/700000000/700000000-GIOT-MAKER -I 700000000-generic-service -u 700000000 -P <PASSWORD>**

Get the data

RECV:

```
{
    "id" : "e18a47a2-9c3c-4157-b61a-5131e34e6813",          // Unique index for this message
    "macAddr" : "04000011",                                 // Module ID
    "data" : "1459268303",                                  // Your Data
    "buff" : "2016-05-09T09:18:56.310Z",                    // LoRa Gateway receive timestamp
    "recv" : "2016-05-09T09:18:55.000Z",                    // Cloud server receive timestamp
    "extra" : {                                             // Lora Gateway which receive your data
    "gwip" : "192.168.1.110",                               // Lora Gateway Wan IP
    "gwid" : “00001c497b48db94",                            // Lora Gateway ID
    "repeater" : "00000000ffffffff",                        // Lora Repeater ID, if bypass
    "systype" : 4,                                          // System ID for indicating service area
    "rssi" : -94,                                           // RSSI when this frame is into Gateway
    "snr" : 93                                              // SNR when this frame is into Gateway
}
```

Project

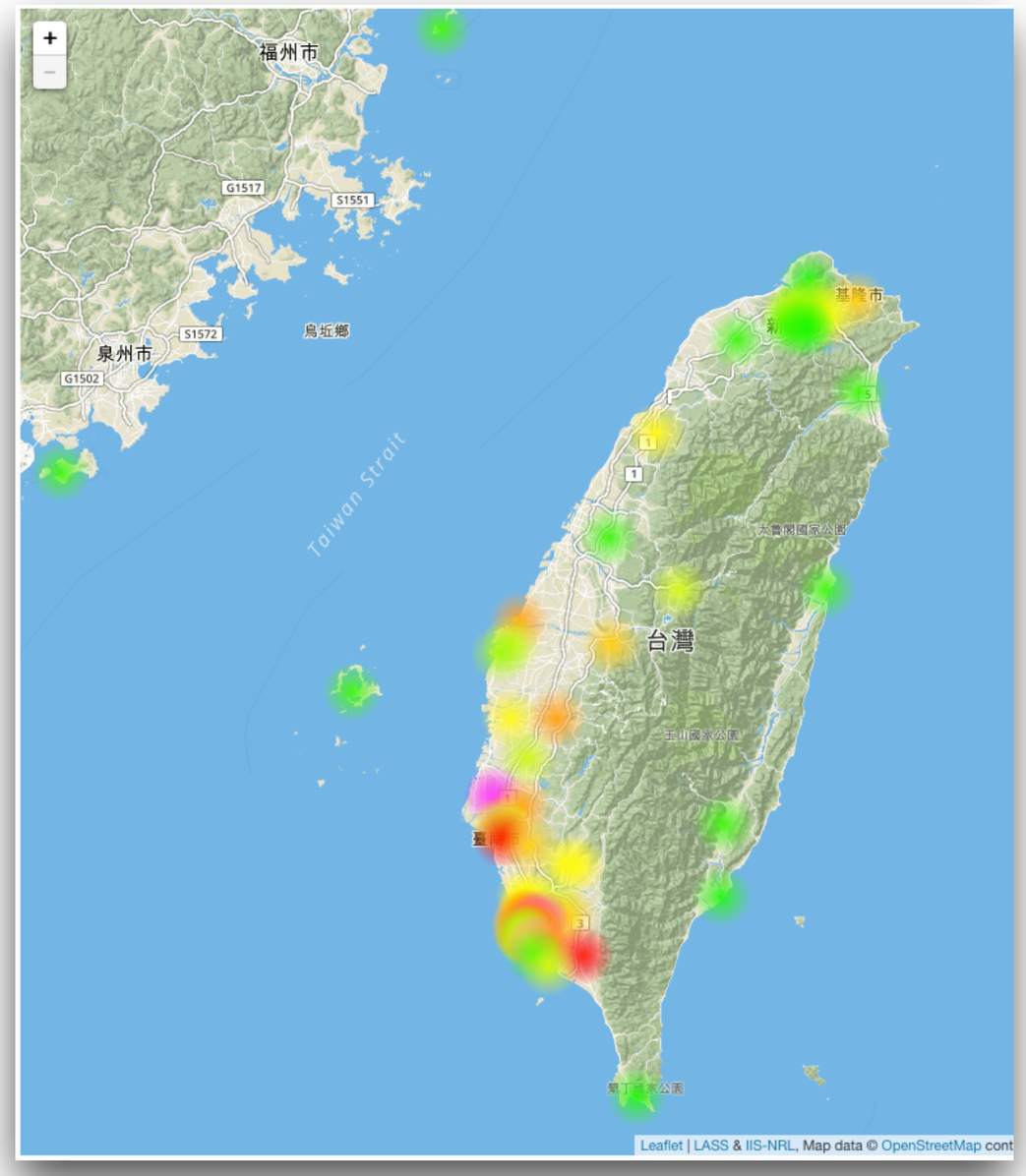
LASS
Location Aware Sensor System

We welcome everyone!

We are open-source & open-data!

We sense anything in our environment!

LASS



- We have 136 nodes in total, 30 nodes online in average
- Have 300 Airbox in Taipei
- 環保署 76 stations，40 nodes from Kaohsiung Webduino，20 nodes from volunteers
- Apply JSON data & GIS service
- Should have 1,000 nodes in 2016

Get data

Gemtek

MQTT broker

MQTT subscribe

LASS data format

LASS

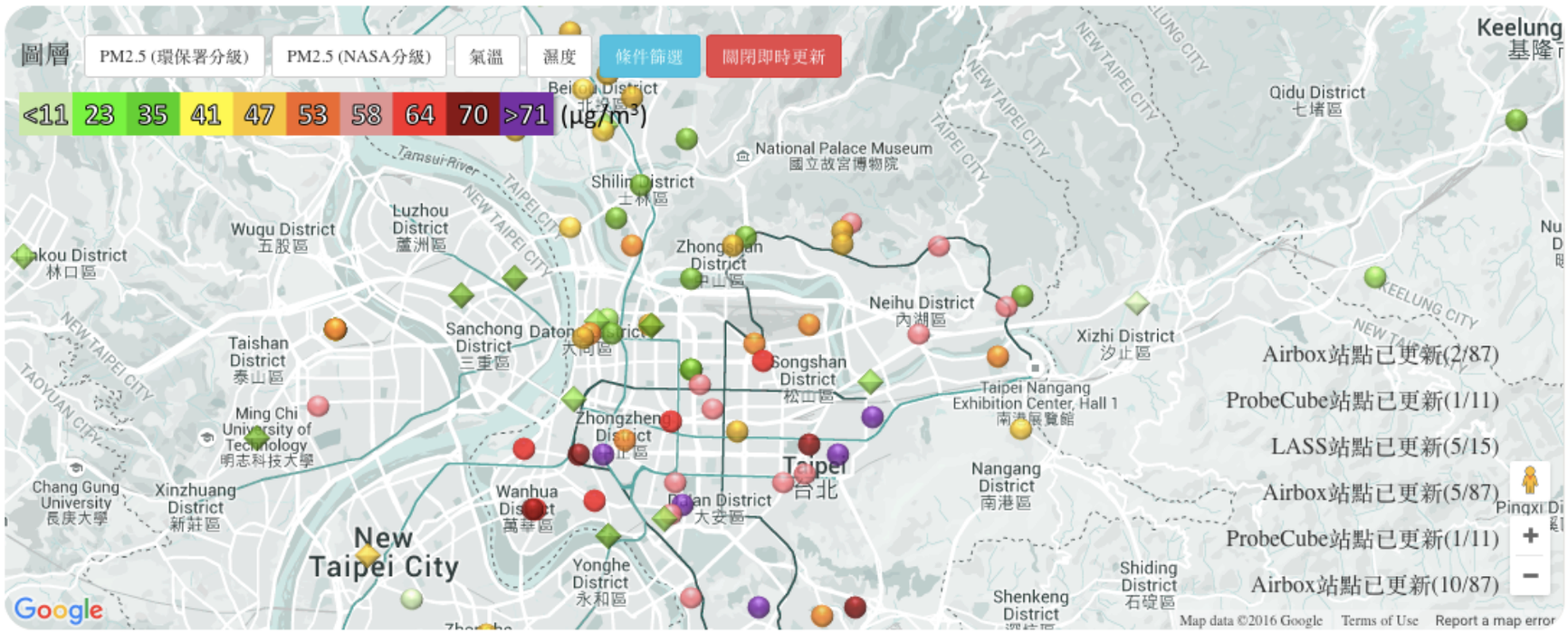
JSON parser

save to DB

Data

Application

GOV 零時空汙觀測網




THANK YOU FOR
LISTENING
ANY QUESTIONS