



การจัดฝึกอบรมเชิงปฏิบัติการหลักสูตร：
LoRaWAN Workshop
For Developer

บริษัท กสท โทรคมนาคม จำกัด (มหาชน)
99 หมู่ 3 ถนนแจ้งวัฒนะ แขวงทุ่งสองห้อง เมืองพะเยา 10210-0298
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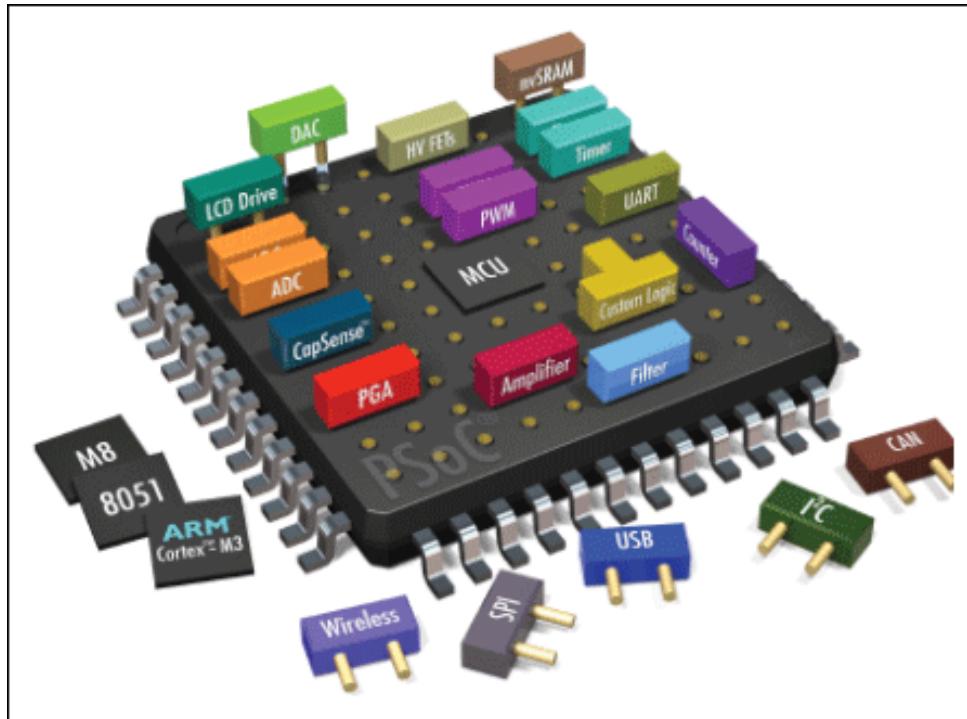
TOPIC

- IoT Concept
- Network Concept
- LoRa Network and Basic Concept
- Workshop : LoRa Account and Device Management
- Workshop : LoRa Example Application

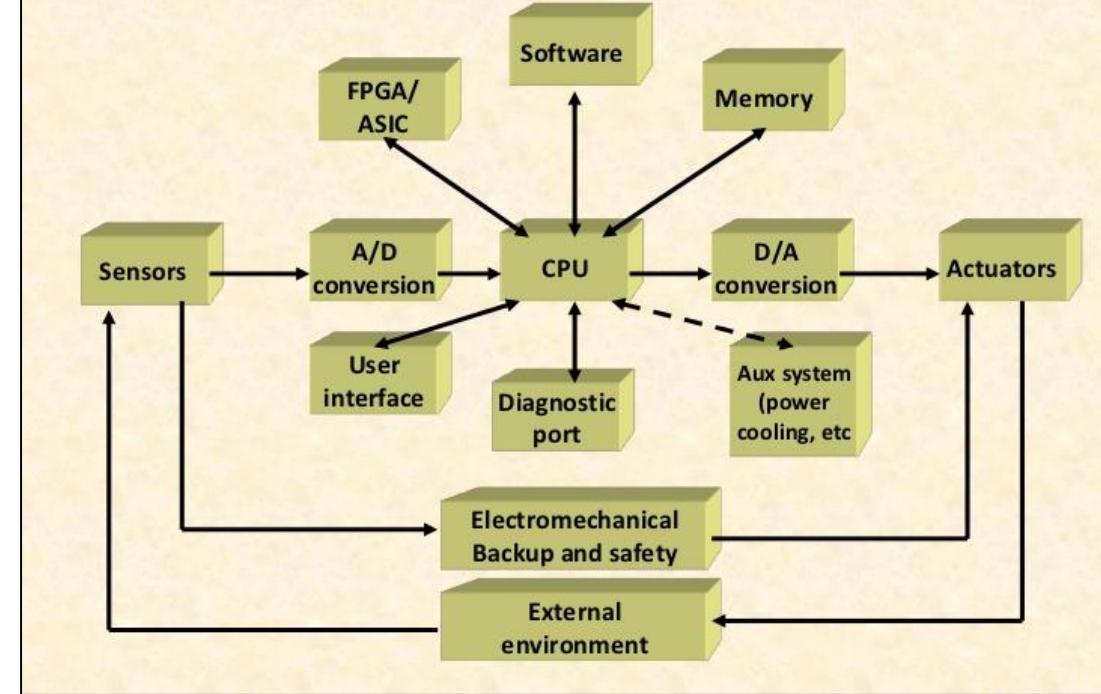
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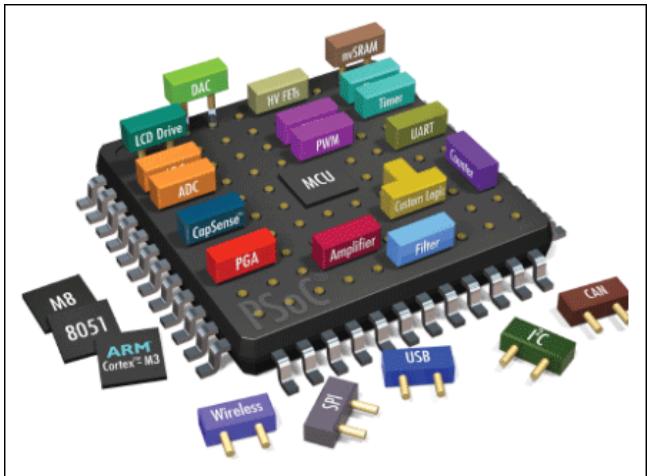
IoT Concept



Embedded system components



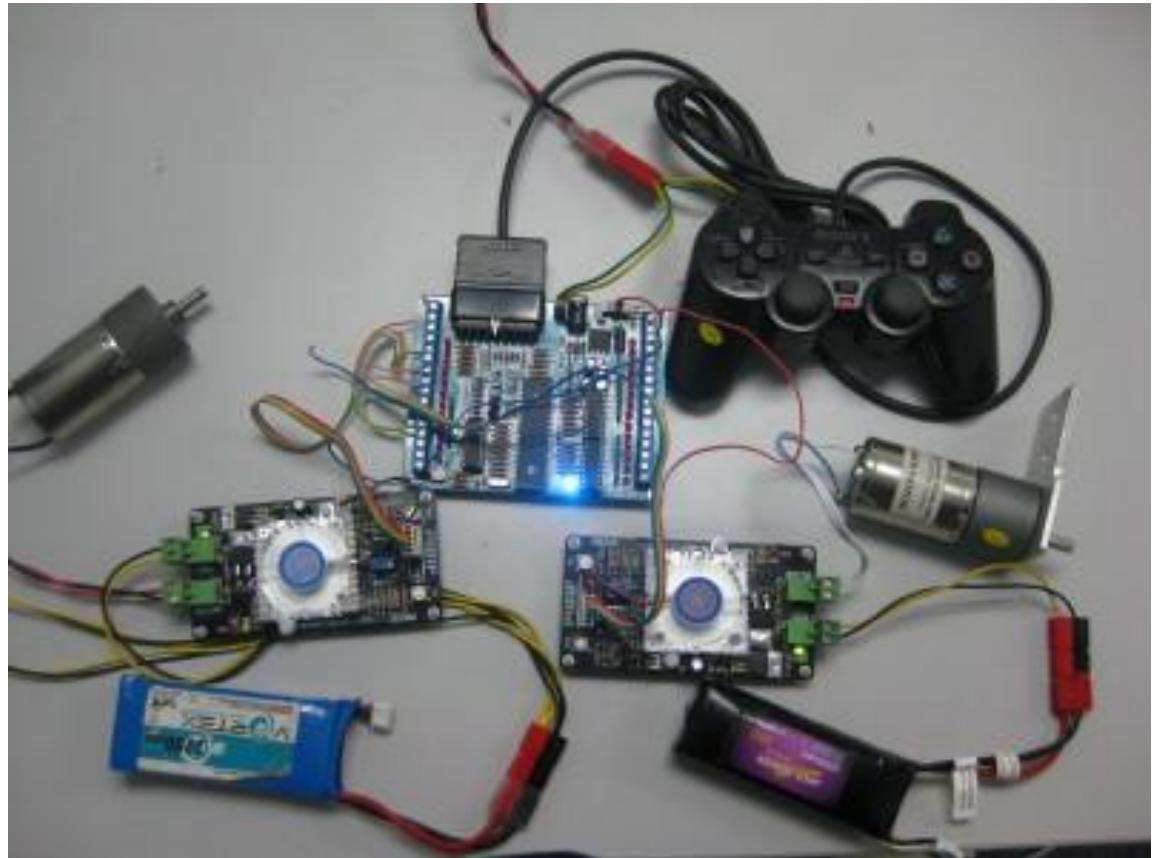
IoT Concept



TOPIC

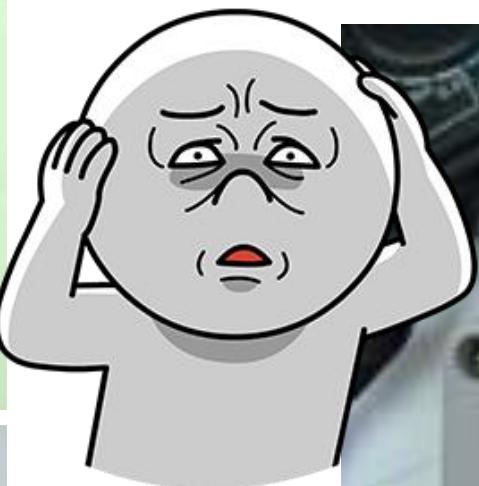
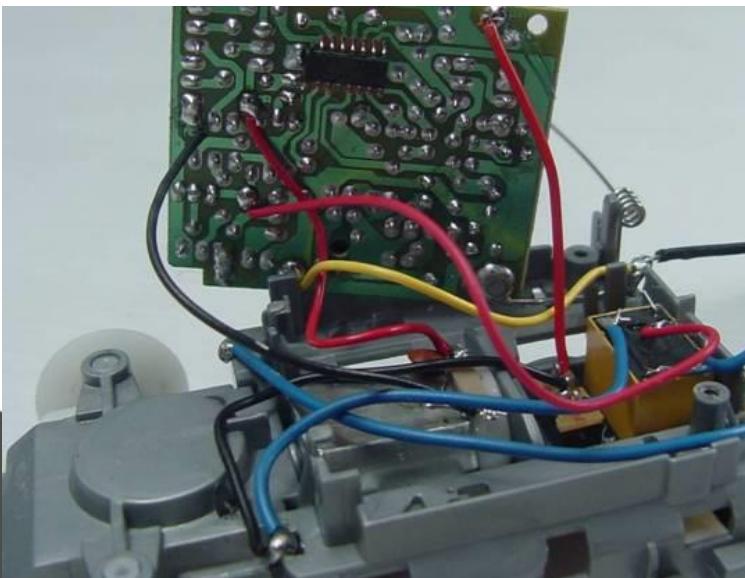
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Network Concept



Network Concept

Hello, Thai Embedded System Association



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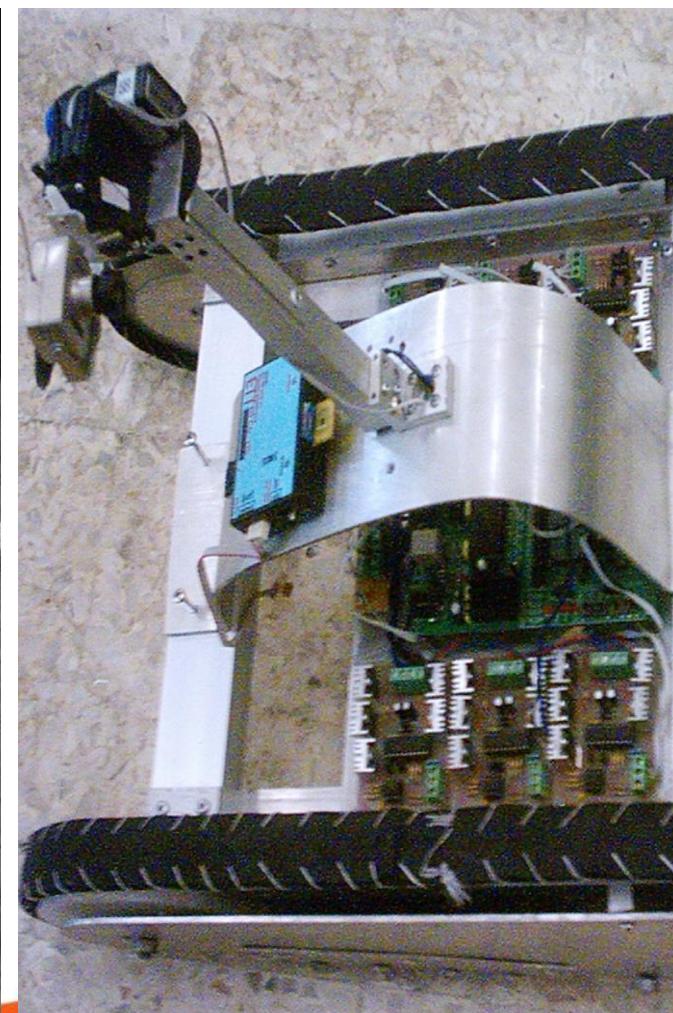
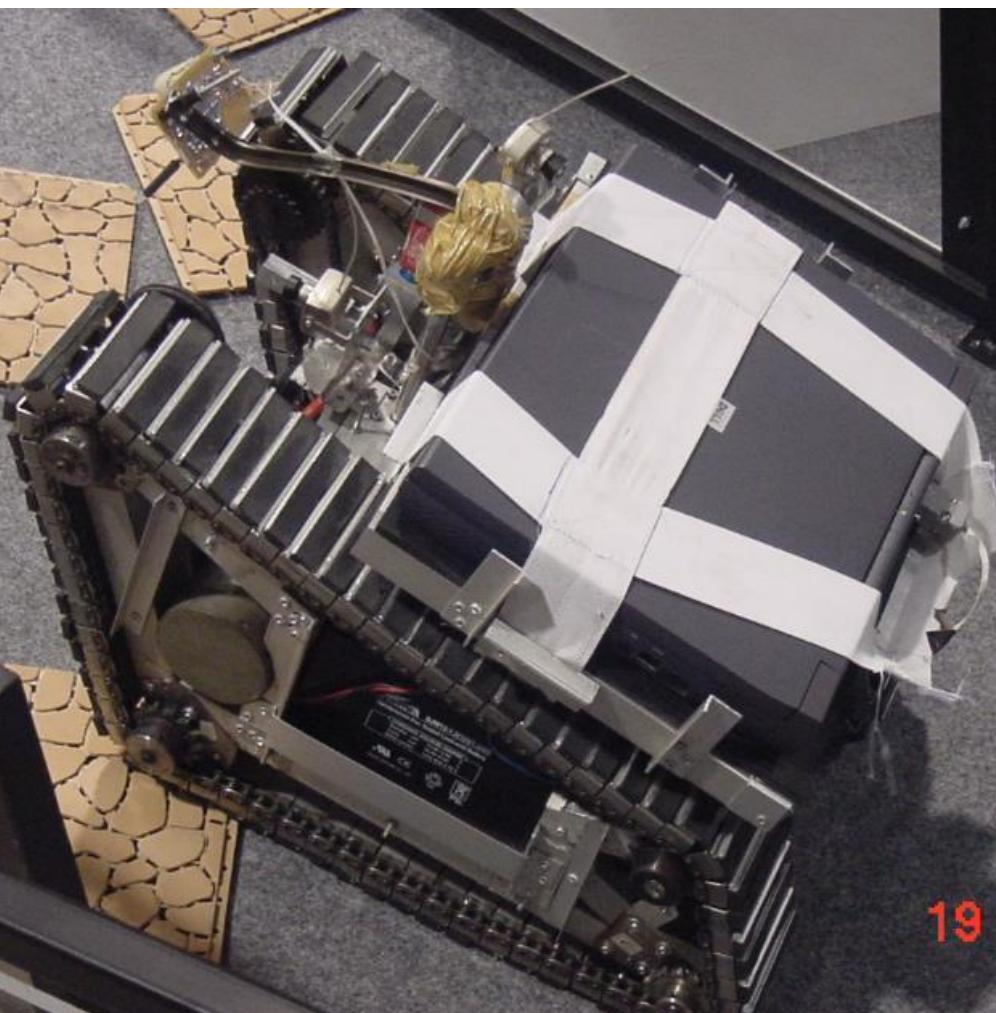
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Network Concept

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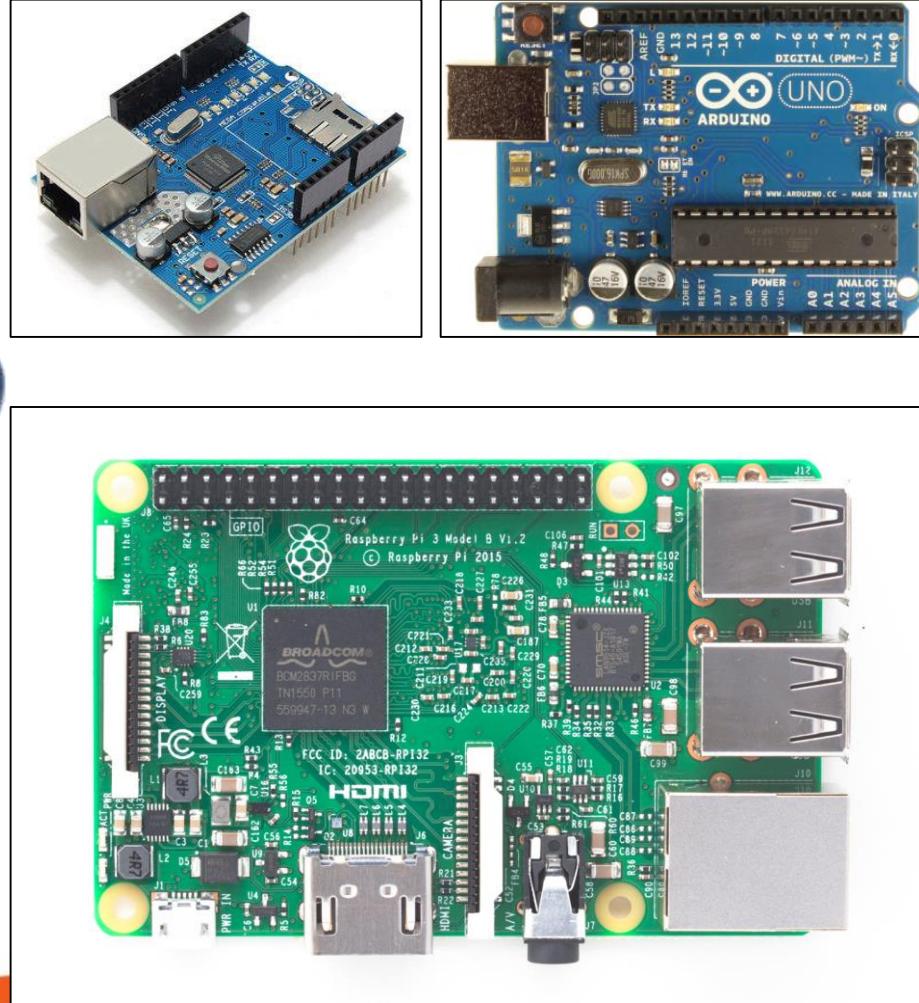
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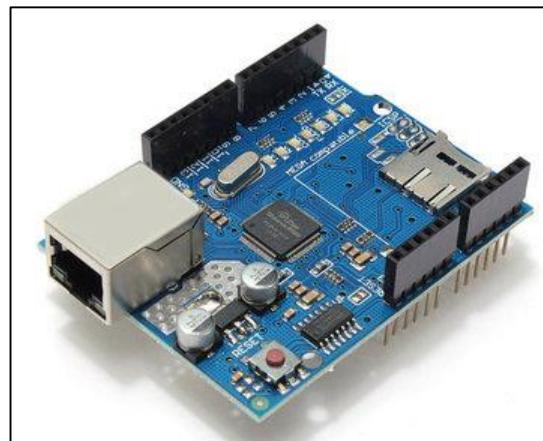
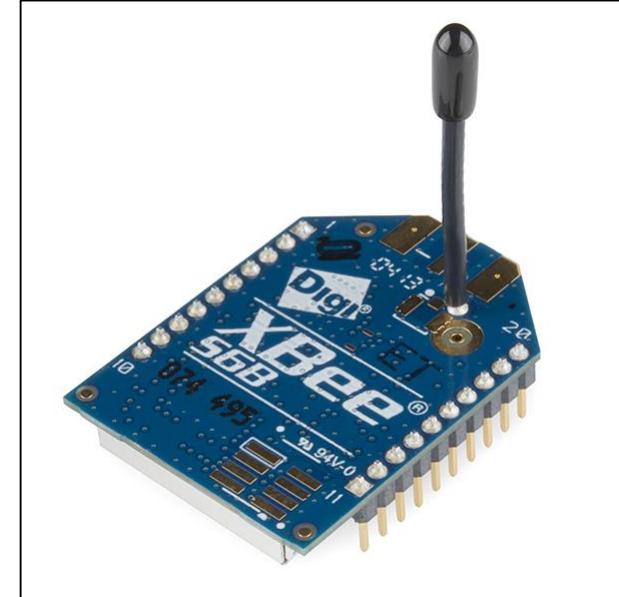
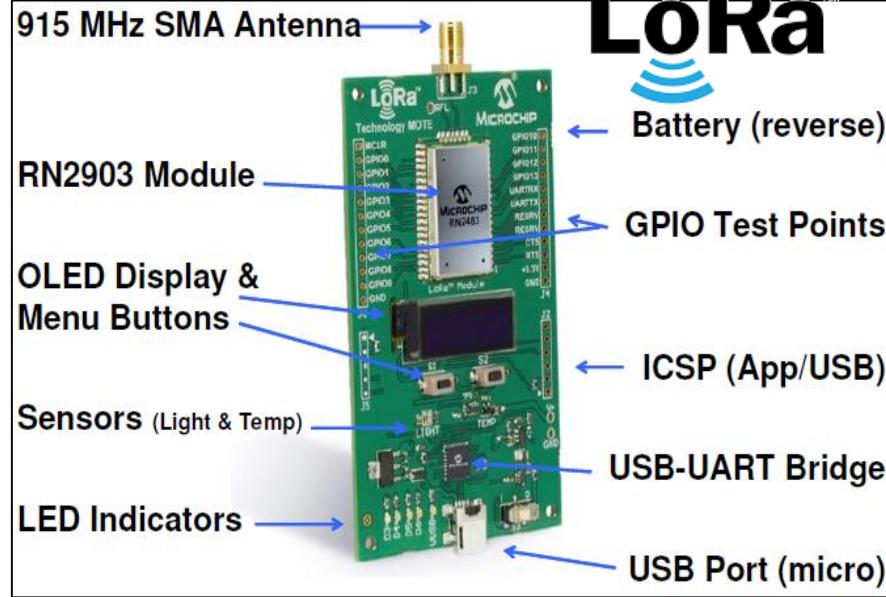
Network Concept

Discussion



Network Concept

Hello, Thai Embedded System Association



Network Concept



Network Concept



Setup Wireless Security Storage Access Restrictions

Basic Wireless Settings | Wireless Security

Manual Wi-Fi Protected Setup™

Network Mode:

Network Name (SSID):

Channel Width:

Channel:

SSID Broadcast: Enabled Disabled

Settings Wi-Fi

Wi-Fi

CHOOSE A NETWORK...

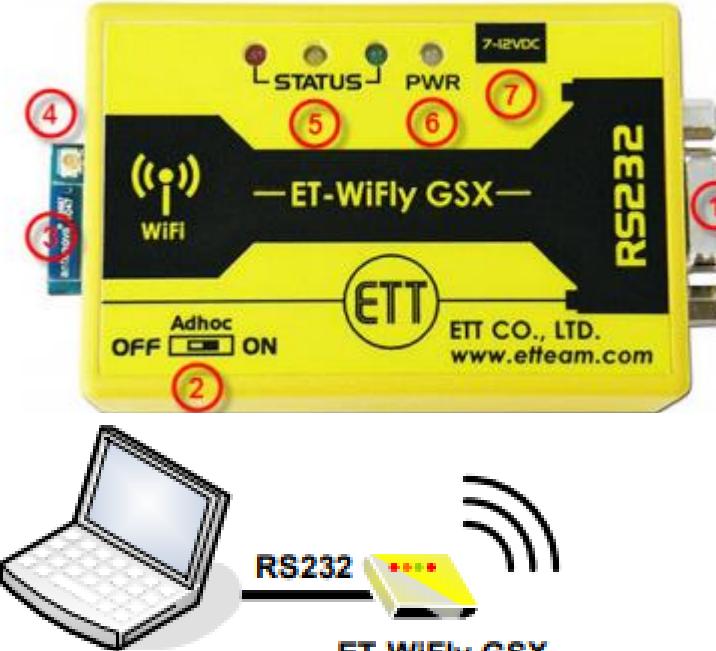
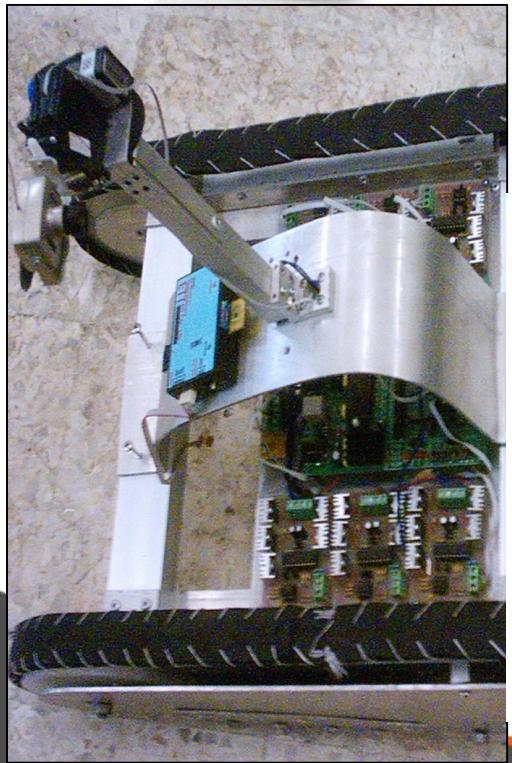
network_name		
Wi-Fi_network		
Wi-Fi_secure		

Other...

Ask to Join Networks

Known networks will be joined automatically.
If no known networks are available, you will have to manually select a network.

Network Concept



Notebook B

SSID:	WiFi-GSX-XX
Channel:	1
DHCP:	OFF
IP address:	169.254.1.1
Netmask:	255.255.0.0
Port:	2000

set wlan join 4	<Enter>	ให้ในมือถือเข้าสู่ Adhoc mode
AOK		
set wlan ssid My_Adhoc	<Enter>	ตั้งชื่อ SSID ของมือถือ
AOK		
set wlan chan 1	<Enter>	เลือกช่องสัญญาณ
AOK		
set ip address 169.254.1.1	<Enter>	ตั้งค่า ip address
AOK		
set ip netmask 255.255.0.0	<Enter>	ตั้งค่า subnet mask
AOK		
set ip dhcp 0	<Enter>	ปิดการทำงาน dhcp
AOK		
save	<Enter>	บันทึกค่า
Storing in config		
reboot	<Enter>	เริ่มการทำงานใหม่

Network Concept

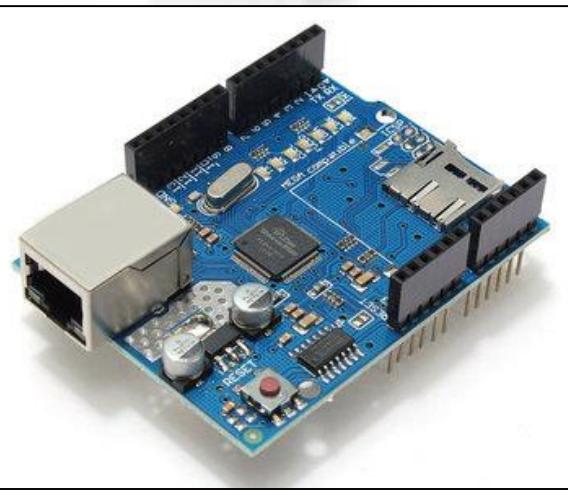


```

1 #include <ESP8266WiFi.h>
2
3 WiFiServer server(88); // ประกาศสร้าง TCP Server ที่พอร์ต 88
4
5 int pin = 2;
6 String line;
7
8 void setup() {
9     pinMode(pin, OUTPUT);
10
11     Serial.begin(115200); // เปิดใช้การ Debug ผ่าน Serial
12     WiFi.mode(WIFI_AP); // ให้งาน WiFi ในโหมด AP
13     WiFi.softAP("ESP_IOXhop"); // ตั้งให้ชื่อ WiFi เป็น ESP_IOXhop
14
15     server.begin(); // เริ่มต้นใช้ TCP Server
16 }
17
18 void loop() {
19     WiFiClient client = server.available();
20     if (!client) // ถ้าไม่มีการเชื่อมต่อมาใหม่
21         return; // ส่งสิ่งค่าว่าง ท้าให้ลุบเนื้อกยอกเลิก
22
23     Serial.println("New client"); // ส่งข้อความว่า New client ไปที่ Serial
24     while (client.connected()) { // วนรอบไปเรื่อยๆ หากยังมีการเชื่อมต่ออยู่
25         if (client.available()) { // ถ้ามีการส่งข้อมูลเข้ามา
26             char c = client.read(); // อ่านข้อมูลอ ก า น 1 ไบต์
27
28             if (c == '\r') { // ถ้าเป็น \r (return)
29                 Serial.println(line); // แสดงตัวแปร line ไปที่ Serial Monitor
30
31             if (line == "LEDON") { // ถ้าส่งข้อความเข้ามาว่า LEDON
32                 digitalWrite(pin, HIGH); // ให้ LED ติด
33             } else { // ถ้าไม่ใช่
34                 digitalWrite(pin, LOW); // ให้ LED ดับ
35             }
36             line = ""; // ล้างค่าตัวแปร line
37             break; // ออกจากลูป
38         } else if (c == '\n') { // ถ้าเป็น \n (new line)
39             // Pass {new line}
40         } else { // ถ้าไม่ใช่
41             line += c; // เพิ่มข้อมูล 1 ไบต์ ไปต่อท้ายในตัวแปร line
42         }
43     }
44     delay(1);
45     client.stop(); // ปิดการเชื่อมต่อกับ Client
46     Serial.println("Client disconnect"); // ส่งข้อความว่า Client disconnect
47 }

```

Network Concept



```
#include "SPI.h"
#include "Ethernet.h"

byte mac[] = { 0xDE, 0xAD, 0xBE, 0xEF, 0xFE, 0xED };
byte server[] = { 173,194,126,119 }; // www.google.co.th

EthernetClient client;

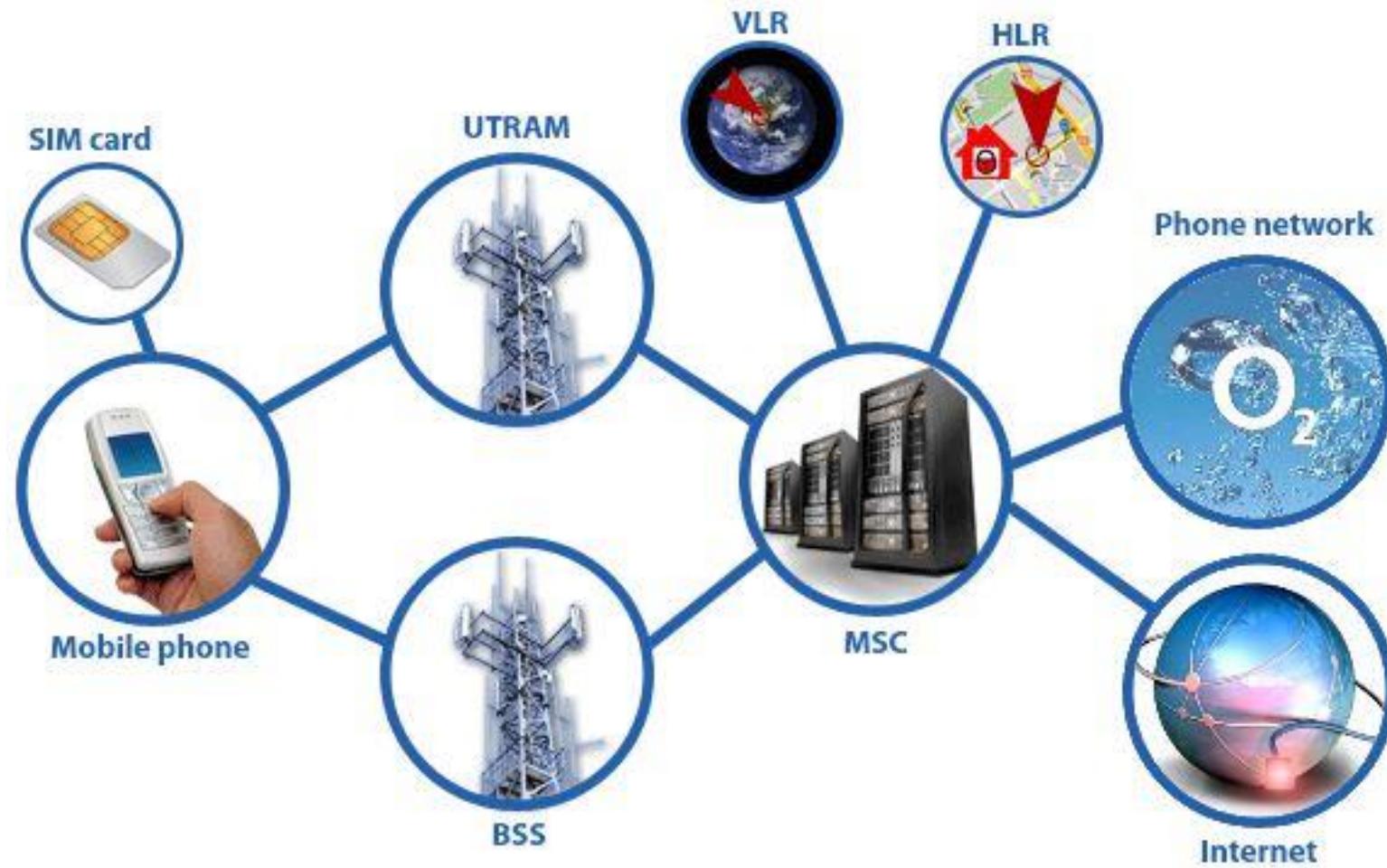
void setup()
{
Serial.begin(9600);
if(Ethernet.begin(mac) == 0) { // start ethernet using mac & DHCP
Serial.println("Failed to configure Ethernet using DHCP");
while(true) // no point in carrying on, so stay in endless loop:
;
}
delay(1000); // give the Ethernet shield a second to initialize

Serial.print("This IP address: ");
IPAddress myIPAddress = Ethernet.localIP();
Serial.print(myIPAddress);
if(client.connect(server, 80)>0) {
Serial.println(" connected");
client.println("GET /search?q=arduino HTTP/1.0");
client.println();
} else {
Serial.println("connection failed");
}
}
```

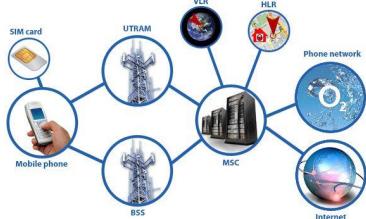
```
void loop()
{
if (client.available()) {
char c = client.read();
// uncomment the next line to show all the received characters
// Serial.print(c);
}

if (!client.connected()) {
Serial.println();
Serial.println("disconnecting.");
client.stop();
for(;;)
;
}
}
```

Network Concept



Network Concept



SIM 800 GSM Module



```
#include "SIM900.h"
#include "SoftwareSerial.h"
##include "inetGSM.h"
##include "sms.h"
##include "call.h"
```

//To change pins for Software Serial, use the two lines in GSM.cpp.

```
//GSM Shield for Arduino
//www.open-electronics.org
//this code is based on the example of Arduino Labs.
```

//Simple sketch to communicate with SIM900 through AT commands.

```
//InetGSM inet;
//CallGSM call;
//SMSGSM sms;

int numdata;
char inSerial[40];
int i=0;
```

```
void serialhwread()
{
    i=0;
    if (Serial.available() > 0) {
        while (Serial.available() > 0) {
            inSerial[i]=(Serial.read());
            delay(10);
            i++;
        }
        inSerial[i]='\0';
        if(!strcmp(inSerial,"/END")) {
            Serial.println("_");
            inSerial[0]=0x1a;
            inSerial[1]='\0';
            gsm.SimpleWriteIn(inSerial);
        }
        //Send a saved AT command using serial port
        if(!strcmp(inSerial,"TEST")) {
            Serial.println("SIGNAL QUALITY");
            gsm.SimpleWriteIn("AT+CSQ");
        } else {
            Serial.println(inSerial);
            gsm.SimpleWriteIn(inSerial);
        }
        inSerial[0]='\0';
    }
}
```

ATT: SHUT OK
RIC:
SHUT OK
status=READY
OK
RING
+CLIP: "0815930607",129,"","","",0
RING
+CLIP: "0815930607",129,"","","",0
RING
+CLIP: "0815930607",129,"","","",0
NO CARRIER

Network Concept



TESA ร่วมกับ มหาวิทยาลัยเทคโนโลยีพระจอมเกล้าพระนครเหนือ กรมอุทยานแห่งชาติ สัตว์ป่า และพันธุ์พืช และ กสท โทรคมนาคม



การประชันทักษะด้านระบบสมองกลฝังตัว
ซึ่งแข่งขันในประเทศไทย ครั้งที่ 12

Smart National Park 4.0

ระบบอัจฉริยะสำหรับอุทยานแห่งชาติ 4.0

วันที่ 7 - 13 มกราคม 2561



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Discussion

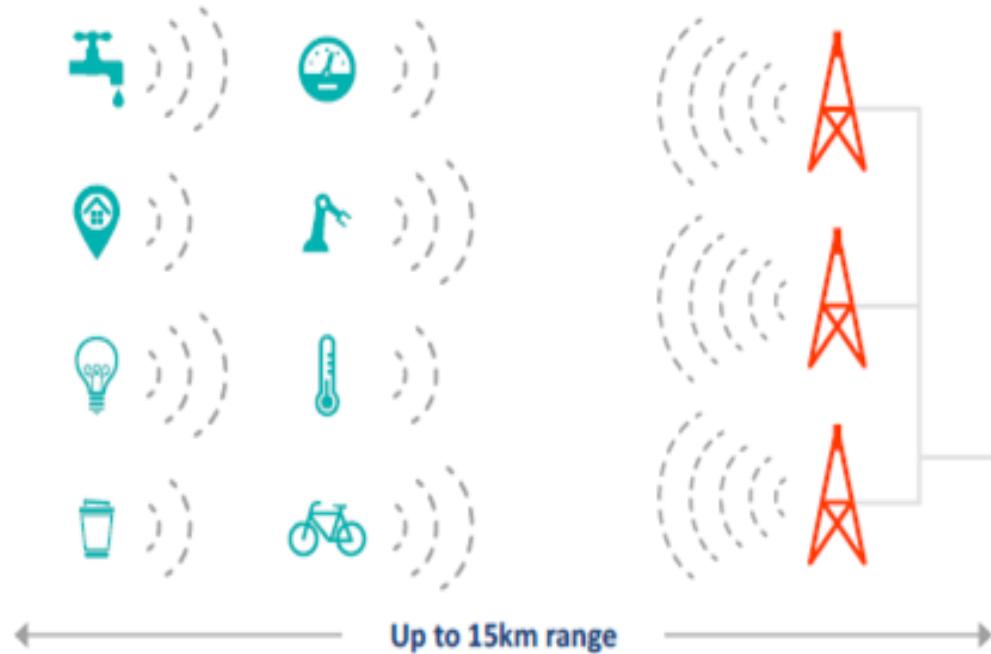


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TOPIC

- IoT Concept
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- **LoRa Network and Basic Concept**
- Workshop : LoRa Account and Device Management
- Workshop : LoRa Example Application

LoRa Network and Basic Concept



Designed for billions of objects

Low battery consumption
10+ years life



LoRa Technology Evaluation Kit

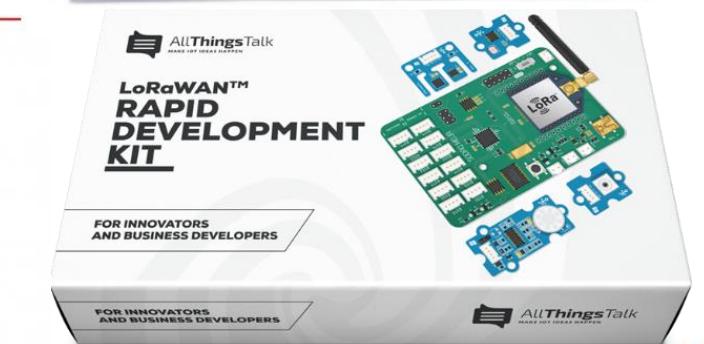
- Everything needed to develop a LoRaWAN™ Network
- 868MHz and 915MHz kits available
- Includes an 8 channel* gateway and 2 motes
- Local LoRaWAN Network/Application server (docker image)
- GUI for Config & Testing (Windows, Linux and MAC OS)
- DV164140-1 (868 MHz); \$499
- DV146140-2 (915 MHz); \$499
- www.microchip.com/LoRa



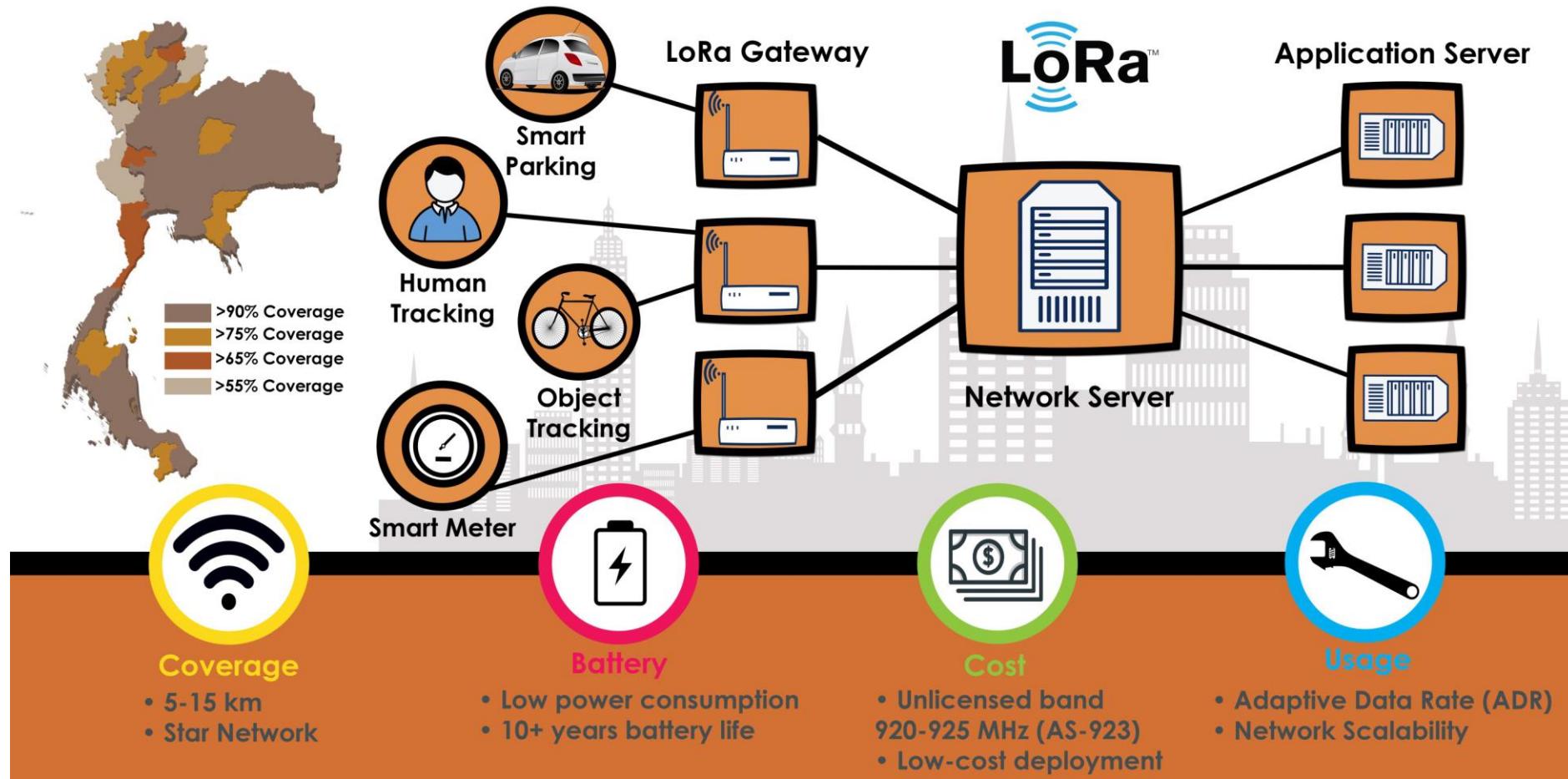
* 6 channel for the DV164140-1

19

STM32 hardware tools
boost LoRa® technology



LoRaWAN Network



LoRaWAN Network



LORA BASIC CONCEPT

- Frequency
- Channel
- Data Rate
- LoRa Class
- Activation Mode
- Data Message (Flow & Payload)
- Configuration

LORA BASIC CONCEPT

- Frequency
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Frequency



In Thailand



Frequency Band	433MHz	920-925 MHz	2.4-2.5 GHz
Availability	 now	 In process	 now
LoRaWAN Regional Parameters	EU 433 MHz ISM Band	AS 923 MHz (APAC Cluster)	International 2.4 GHz ISM Band
Transceiver Modules (Examples, not limited to)	Semtech SX1276-1279 Semtech SX1236	Semtech SX1276-1279 Semtech SX1272-1273	Semtech SX1280 Semtech SX1281
Frequency Plan		LoRa Regional Parameters v. 1.0.2	
Operating Range	10-30 km	7-15 km	3-7 km
Applications	<ul style="list-style-type: none"> • Automated Meter Reading • Building Automation • Wireless Alarm and Security Systems • Industrial Monitoring and Control • Long range precision farming 	<ul style="list-style-type: none"> • Automated Meter Reading • Building Automation • Wireless Alarm and Security Systems • Industrial Monitoring and Control • Long range precision farming 	<ul style="list-style-type: none"> • Home automation • Tracking applications • Wearables & sports/fitness sensors • Radio-controlled toys & drones • Smart watches & beacons

Frequency



With AS923 Mhz ISM Band



2.7.2 AS923 ISM Band channel frequencies

This section applies to regions where the frequencies [923... 923.5MHz] are comprised in the ISM band, which is the case for the following countries:

- ❖ Brunei [923-925 MHz]
- ❖ Cambodia [923-925 MHz]
- ❖ Hong Kong [920-925 MHz]
- ❖ Indonesia [923-925 MHz]
- ❖ Japan [920-928 MHz]
- ❖ Laos [923-925 MHz]
- ❖ New Zealand [915-928 MHz]
- ❖ Singapore [920-925 MHz]
- ❖ Taiwan [922-928 MHz]
- ❖ Thailand [920-925 MHz]
- ❖ Vietnam [920-925 MHz]

End-point max power := 14 dBm ERP = 25mW ERP= 41 mW e.i.r.p.

Channel plan and configuration please see: "LoRaWAN Regional Parameters 1.0.2"
https://portal.lora-alliance.org/DesktopModules/Inventures_Document/FileDownload.aspx?ContentID=1397

Frequency

Options for Target 'mlm32I07x01'

- [Device](#)
- [Target](#)
- [Output](#)
- [Listing](#)
- [User](#)
- [C/C++](#)
- [Asm](#)
- [Linker](#)
- [Debug](#)
- [Utilities](#)

Preprocessor Symbols

Define: STM32L072xx,USE_B_L072Z_LRWAN1,USE_HAL_DRIVER,REGION_AS923

Undefine:

Language / Code Generation

Execute-only Code Strict ANSI C
 Optimization: Level 3 (-O3) Enum Container always int Warnings: All Warnings
 Optimize for Time Plain Char is Signed
 Split Load and Store Multiple Read-Only Position Independent Thumb Mode
 One ELF Section per Function Read-Write Position Independent No Auto Includes
 C99 Mode

```

#define AS923_BAND0           { 100, AS923_DEFAULT_TX_POWER, 0, 0 } // 1.0 %

/*
 * LoRaMac default channel 1
 * Channel = { Frequency [Hz], RX1 Frequency [Hz], { ( ( DrMax << 4 ) | DrMin ) }, Band }
 */
#define AS923_LC1             { 923200000, 0, { ( ( DR_5 << 4 ) | DR_0 ) }, 0 }

/*
 * LoRaMac default channel 2
 * Channel = { Frequency [Hz], RX1 Frequency [Hz], { ( ( DrMax << 4 ) | DrMin ) }, Band }
 */
#define AS923_LC2             { 923400000, 0, { ( ( DR_5 << 4 ) | DR_0 ) }, 0 }
  
```

LORA BASIC CONCEPT

- Frequency
- Channel
- Data Rate
- LoRa Class
- Activation Mode
- Data Message (Flow & Payload)
- Configuration

Channel

AS923-925

Used in Brunei, Cambodia, Hong Kong, Indonesia, Laos, Taiwan, Thailand, Vietnam

Channel	Frequency
1	923.2
2	923.4
3	922.0
4	922.2
5	922.4
6	922.6
7	922.8
8	923.0

Channel	Frequency
9	920.4
10	920.6
11	920.8
12	921.0
13	921.2
14	921.4
15	921.6
16	921.8

LORA BASIC CONCEPT

- Frequency
- Channel
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Data Rate

Spreading Factor (at 125 kHz)	Bitrate	Range	Time on Air (ms)
SF7	5470 bps	2 km	56 ms
SF8	3125 bps	4 km	100 ms
SF9	1760 bps	6 km	200 ms
SF10	980 bps	8 km	370 ms
SF11	440 bps	11 km	740 ms
SF12	290 bps	14 km	1400 ms

Show the Data Rate as function of the distance and the Spreading Factor (SF).

LoRaWAN optimizes the communication by **Adaptative Data Rate** >> The network instructs a node to perform a rate adaptation by using a requested data rate (and a requested TX Power).

Data Rate

2.7.6 AS923 Maximum payload size

The maximum **MACPayload** size length (M) is given by the following table for both dwell time configurations: No Limit and 400ms. It is derived from the PHY layer limitation depending on the effective modulation rate used taking into account a possible repeater encapsulation layer.

DataRate	<i>Uplink MAC Payload Size (M)</i>		<i>Downlink MAC Payload Size (M)</i>	
	UplinkDwellTime = 0	UplinkDwellTime = 1	DownlinkDwellTime = 0	DownlinkDwellTime = 1
0	59	N/A	59	N/A
1	59	N/A	59	N/A
2	59	19	59	19
3	123	61	123	61
4	230	133	230	133
5	230	250	230	250
6	230	250	230	250
7	230	250	230	250
8:15	RFU		RFU	

Table E2 - AS923 maximum payload size

LORA BASIC CONCEPT

- Frequency
- Channel
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LoRa Class

Class Name	Intended Usage
A ("all")	Battery powered sensors (or actuators with no latency constraint) Most energy efficient communication class. Must be supported by all devices.
B ("beacon")	Battery powered actuators Energy efficient communication class for latency controlled downlink. Based on slotted communication synchronized with a network beacon.
C ("continuous")	Main powered actuators Devices which can afford to listen continuously. No latency for downlink communication.

LORA BASIC CONCEPT

- Frequency
- Channel
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Activation Mode

Over-the-Air Activation (OTAA)

- Based on Globally Unique Identifier
- Over the air message handshaking



Activation By Personalization (ABP)

- Shared keys stored at production time
- Locked to a specific network



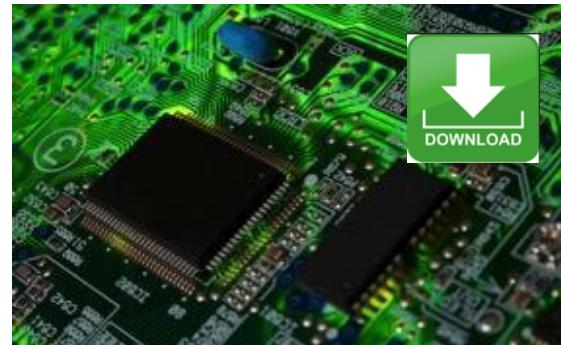
Activation Mode : Over-the-Air Activation (OTAA)

- End-device transmits **Join Request** to application server containing:
 - Globally unique end-device identifier (**DevEUI**)
 - Application identifier (**AppEUI**)
 - Authentication with Application key (**AppKey**)
- End-device receives **Join Accept** from application server
- End-device authenticates **Join Accept**
- End-device **decrypts** Join Accept
- End-device extracts and stores Device Address (**DevAddr**)
- End-device **derives**:
 - Network Session Key (**NwkSKey**)
 - Application Session Key (**AppSKey**)



Activation Mode : Activation By Personalization (ABP)

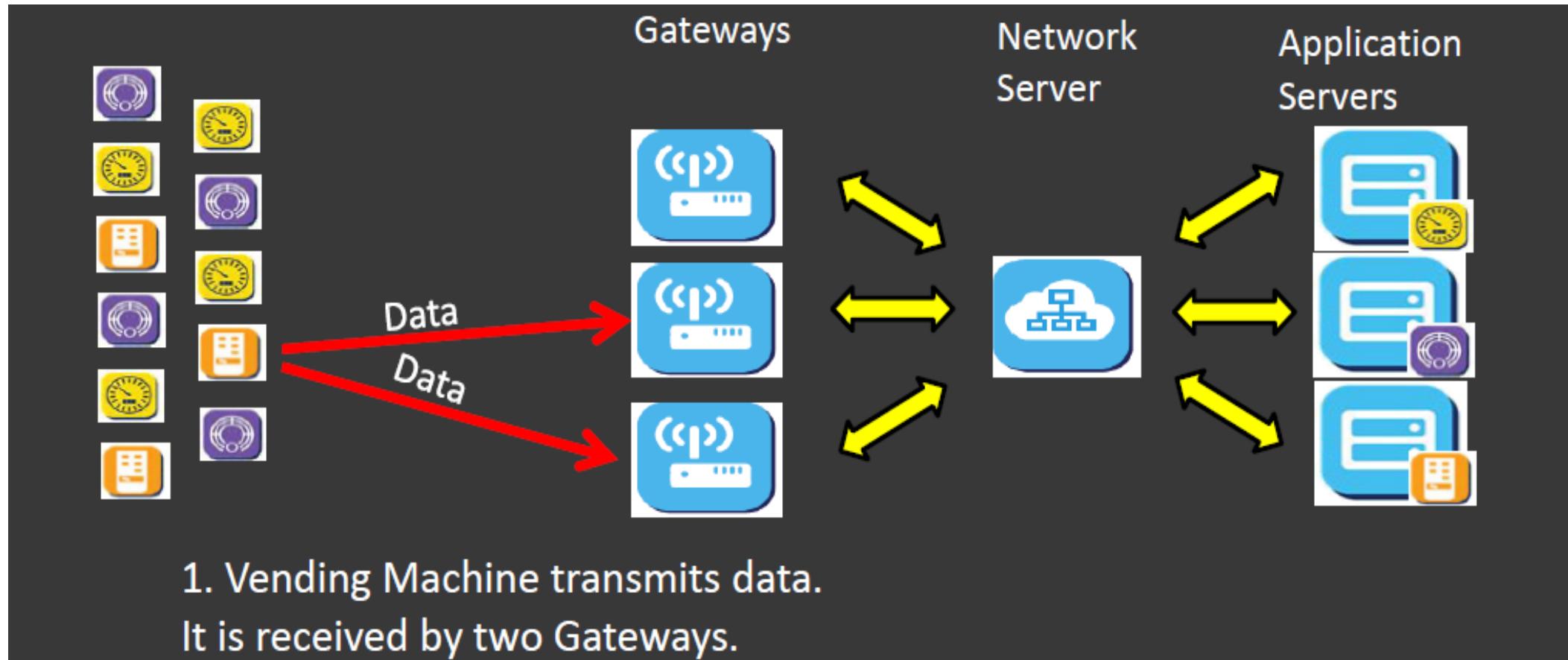
- The following information is configured at production time:
 - Device Address (**DevAddr**)
 - Network Session Key (**NwkSKey**)
 - Application Session Key (**AppSKey**)
- **No over the air handshaking**
- Device is ready to communicate on the network without any additional procedure.



LORA BASIC CONCEPT

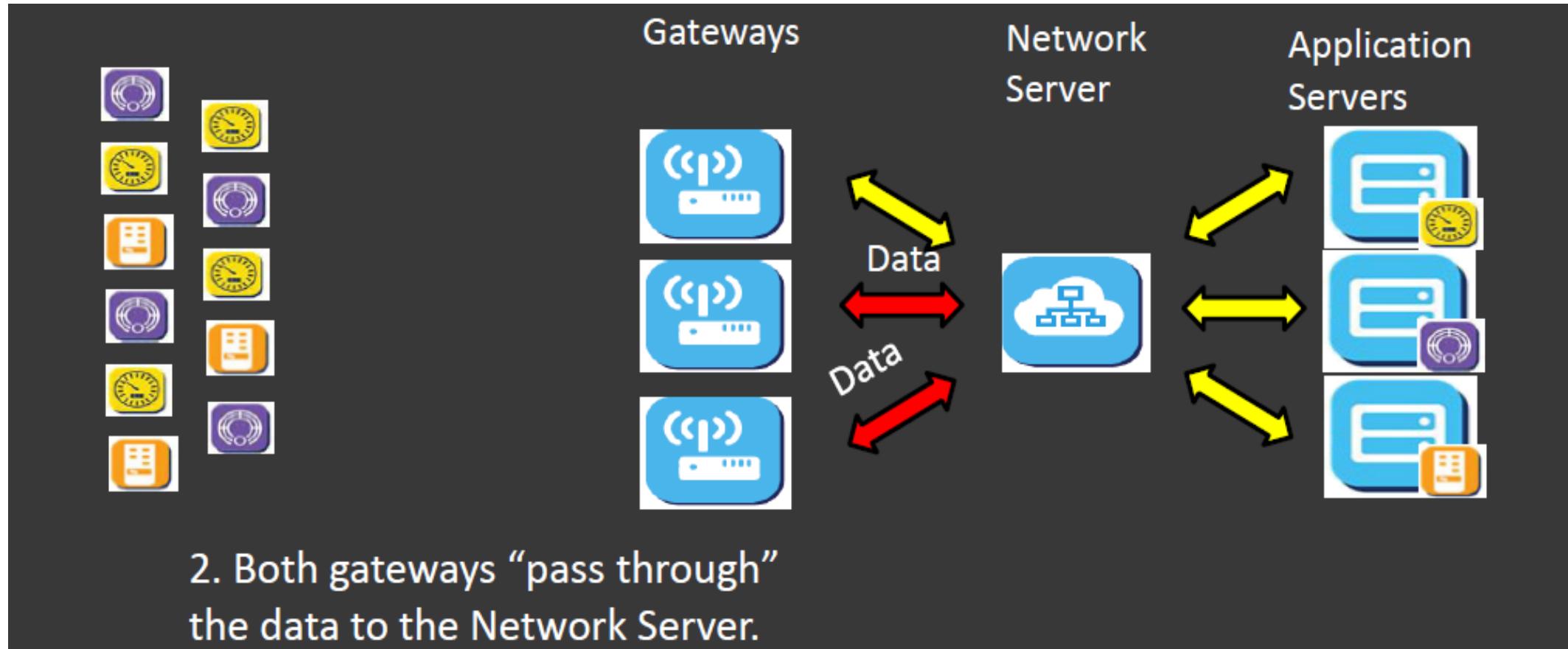
- Frequency
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Data Message (Flow & Payload)



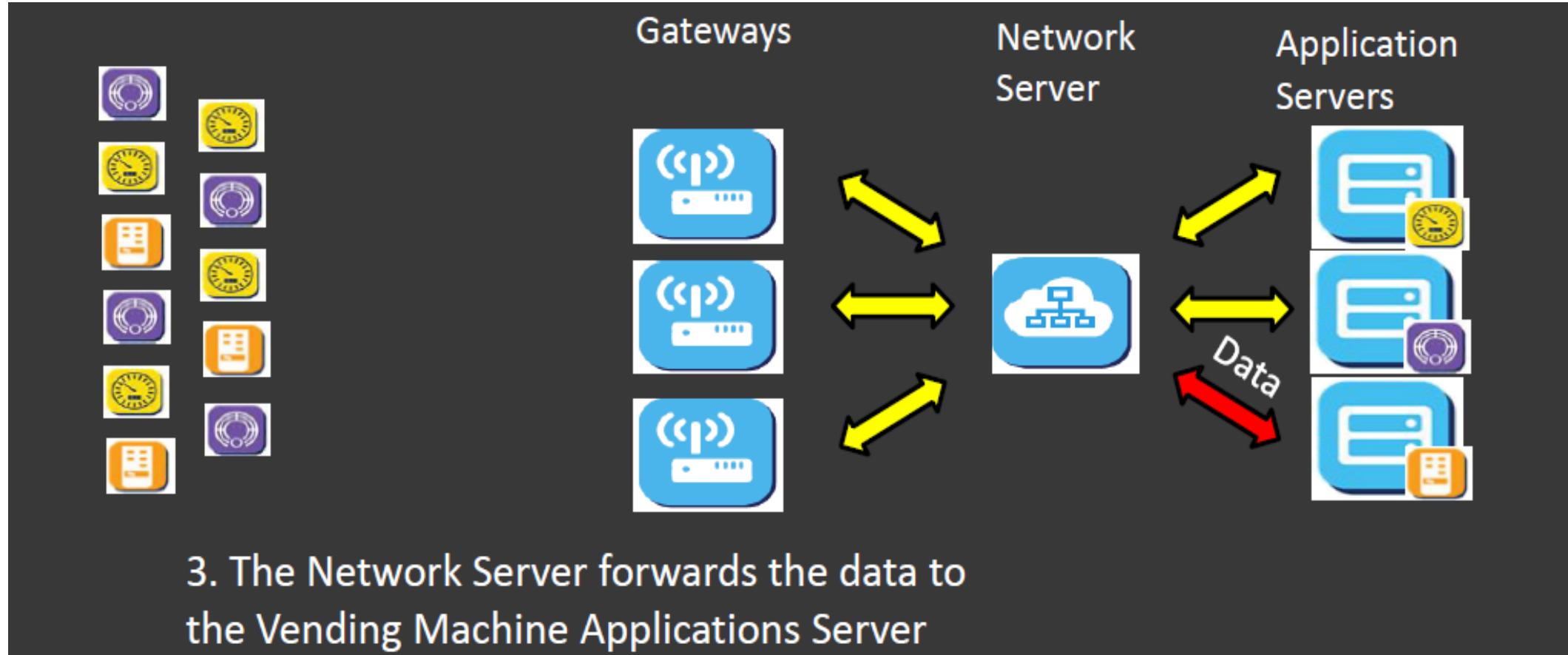
Ref: LoRa-Aliance.org

Data Message (Flow & Payload)



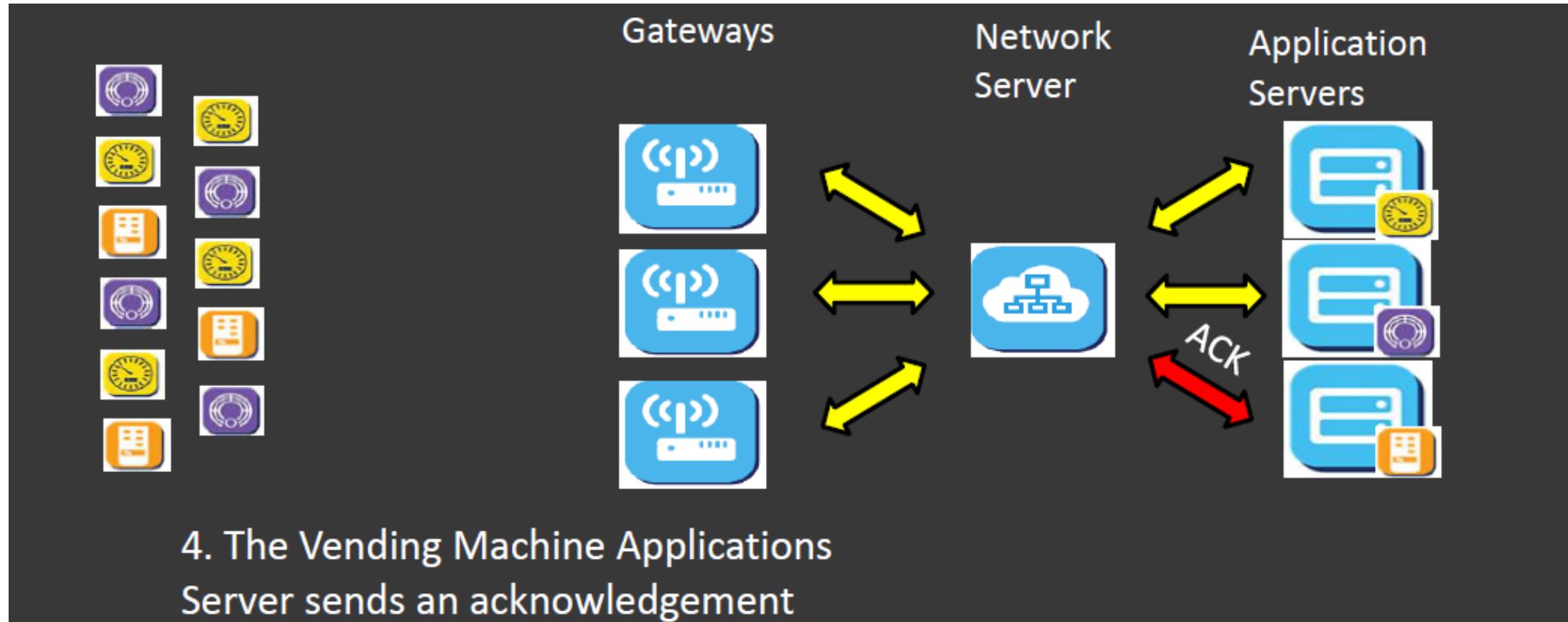
Ref: LoRa-Aliance.org

Data Message (Flow & Payload)



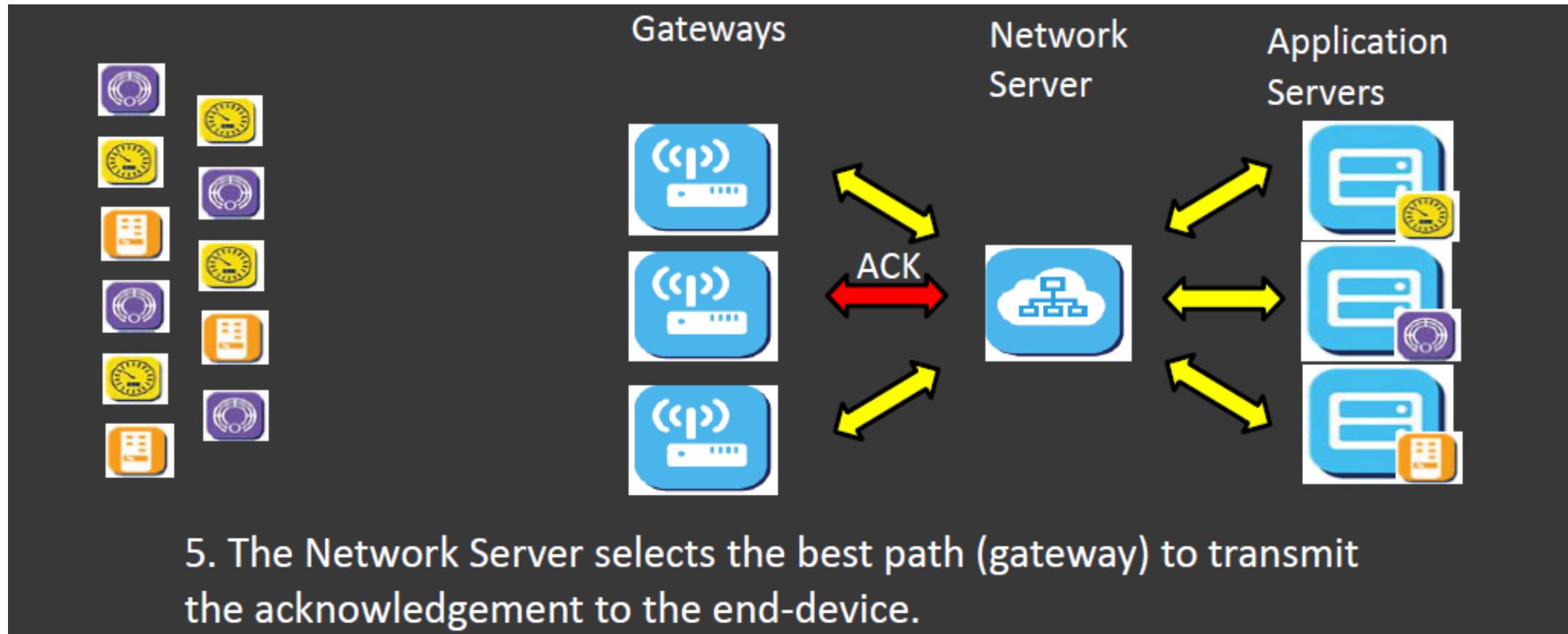
Ref: LoRa-Aliance.org

Data Message (Flow & Payload)



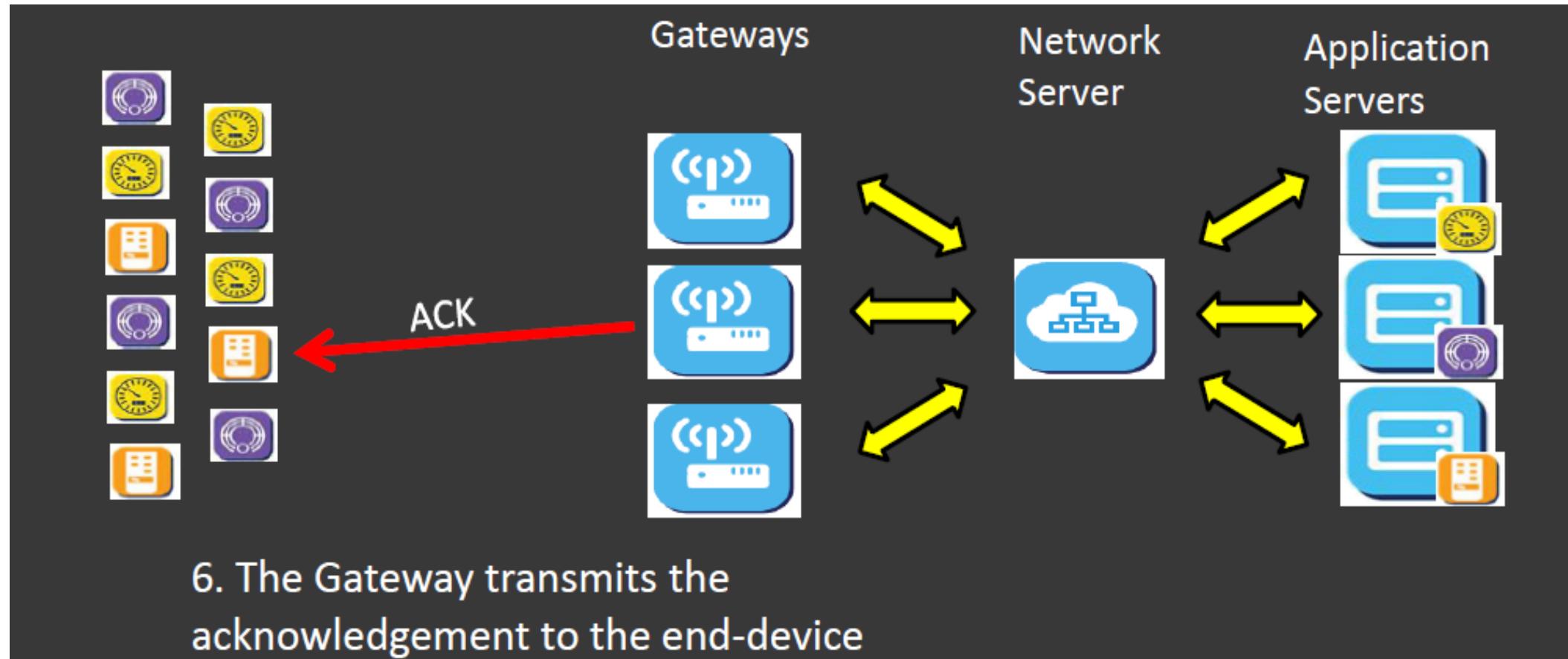
Ref: LoRa-Aliance.org

Data Message (Flow & Payload)



Ref: LoRa-Aliance.org

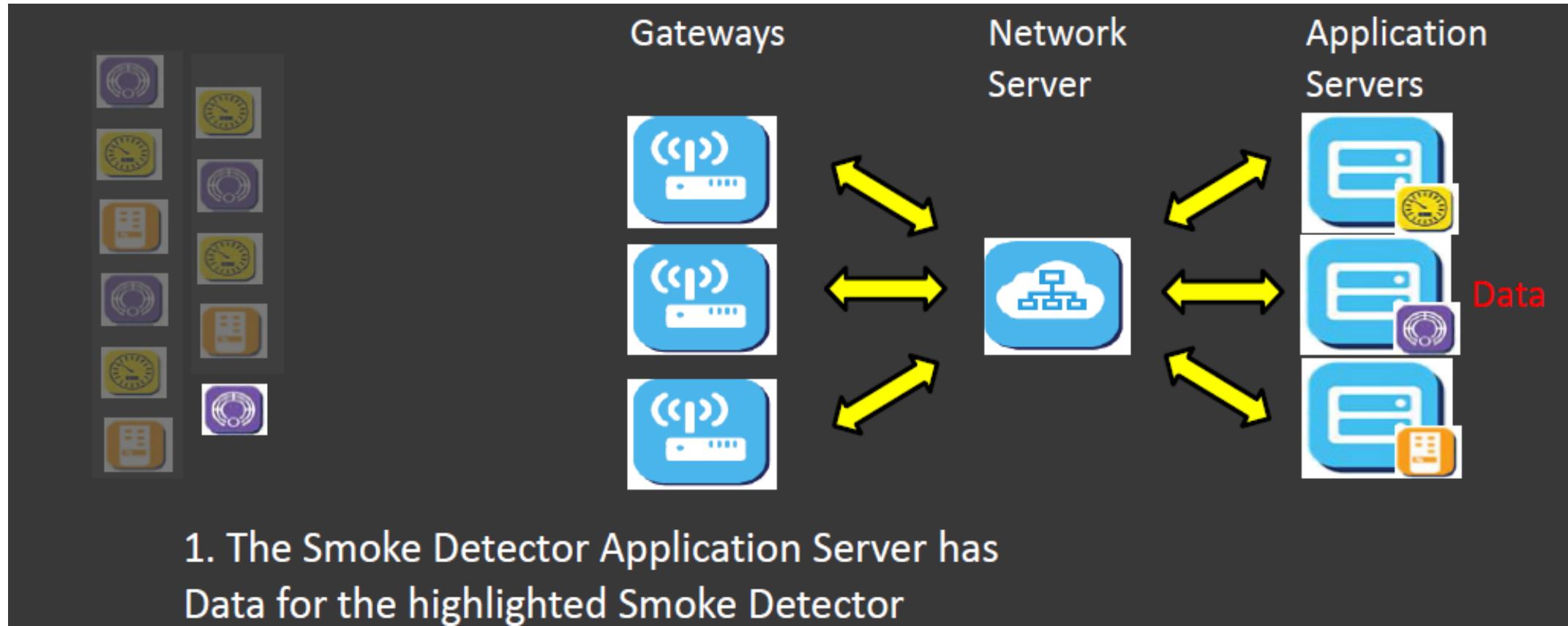
Data Message (Flow & Payload)



Ref: LoRa-Aliance.org

Data Message (Flow & Payload)

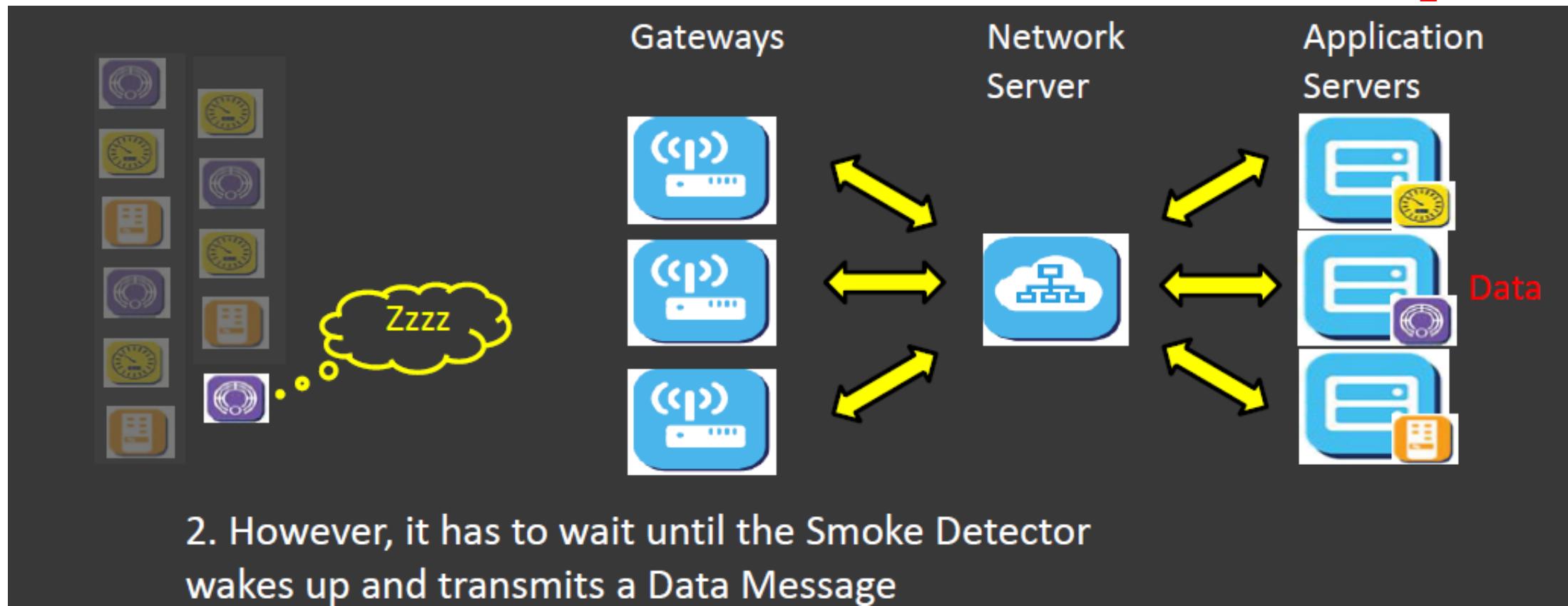
Download & Upload



Ref: LoRa-Aliance.org

Data Message (Flow & Payload)

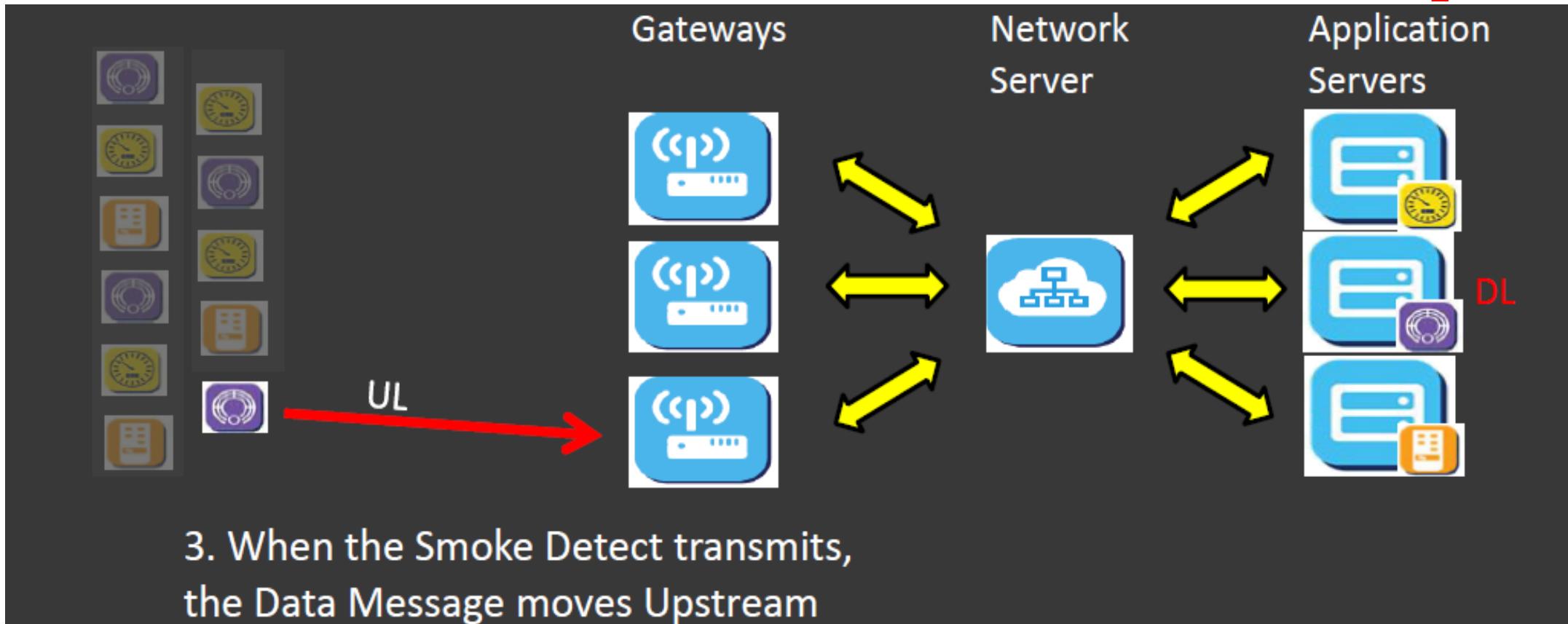
Download & Upload



Ref: LoRa-Aliance.org

Data Message (Flow & Payload)

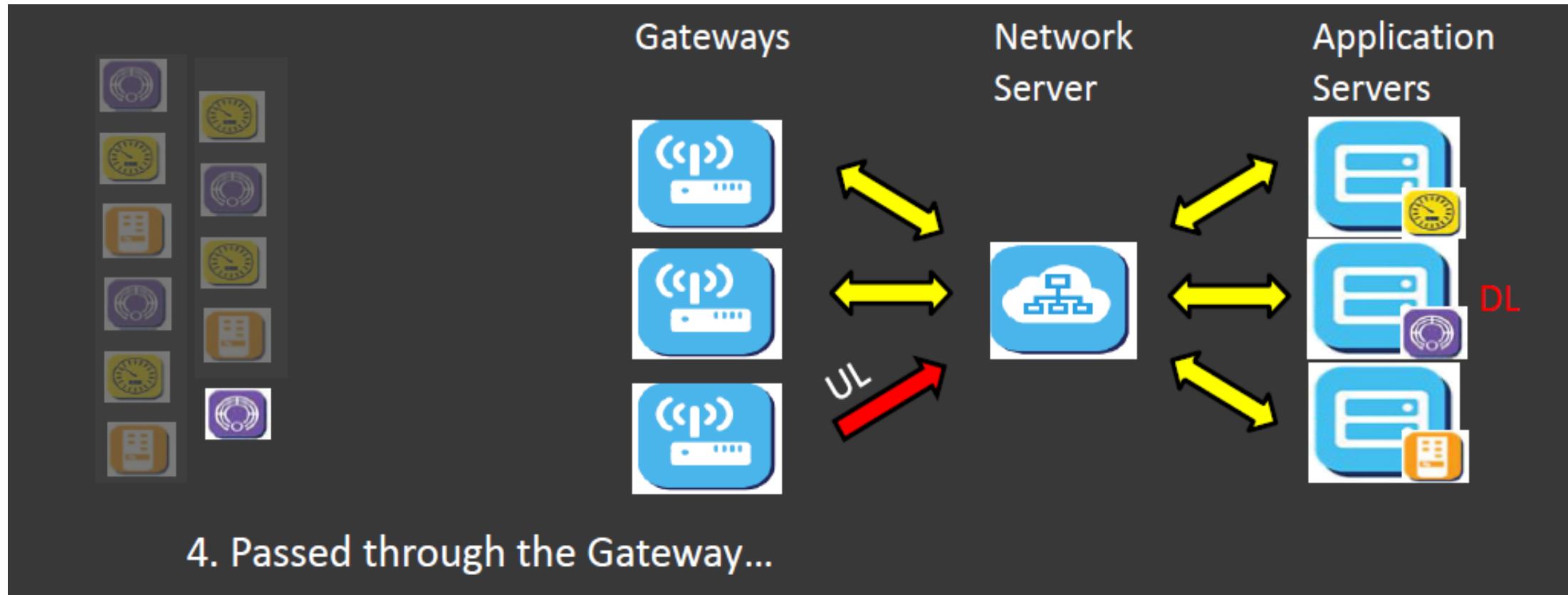
Download & Upload



Ref: LoRa-Aliance.org

Data Message (Flow & Payload)

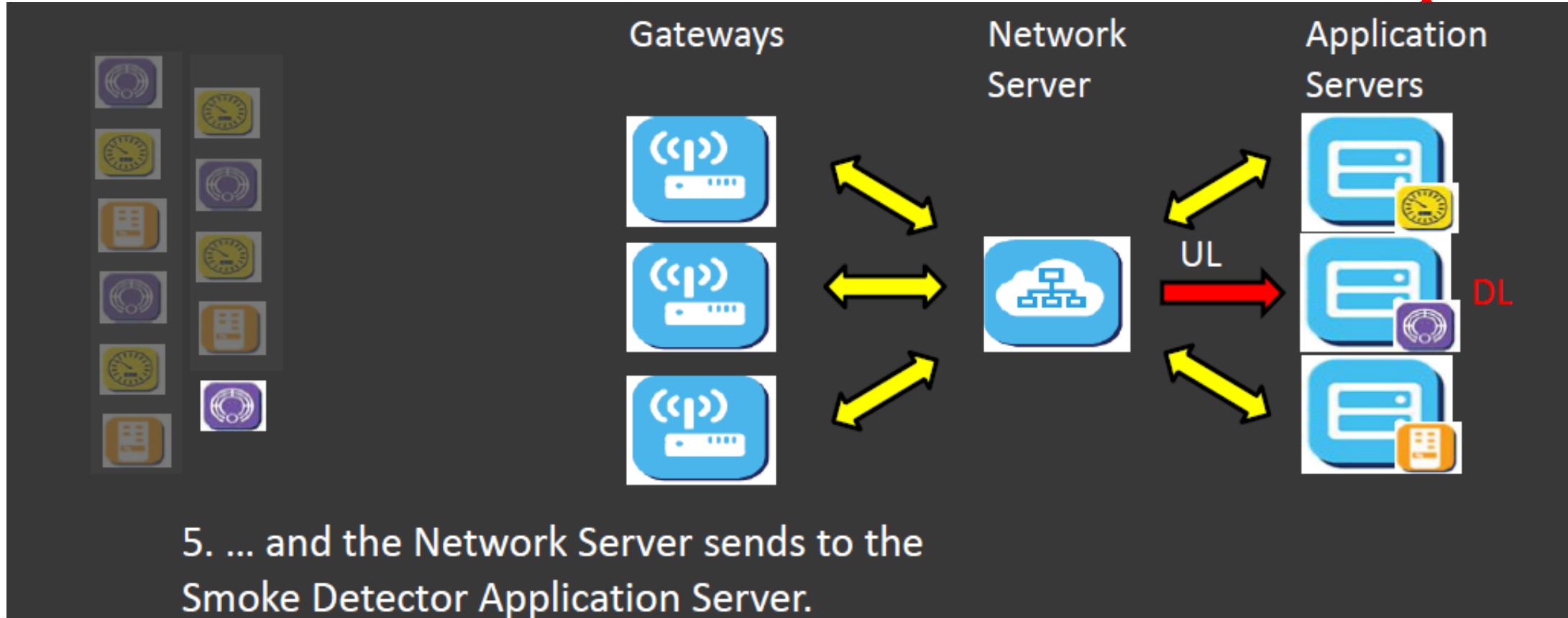
Download & Upload



Ref: LoRa-Aliance.org

Data Message (Flow & Payload)

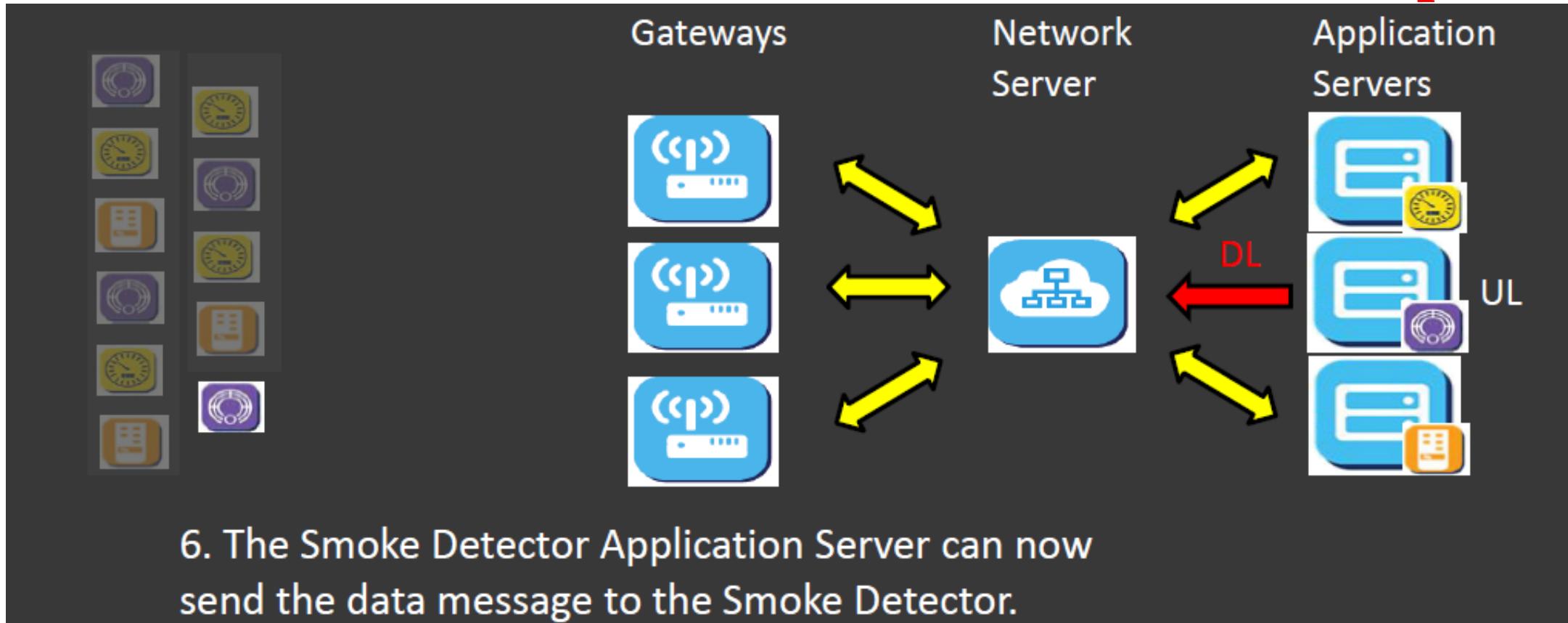
Download & Upload



Ref: LoRa-Aliance.org

Data Message (Flow & Payload)

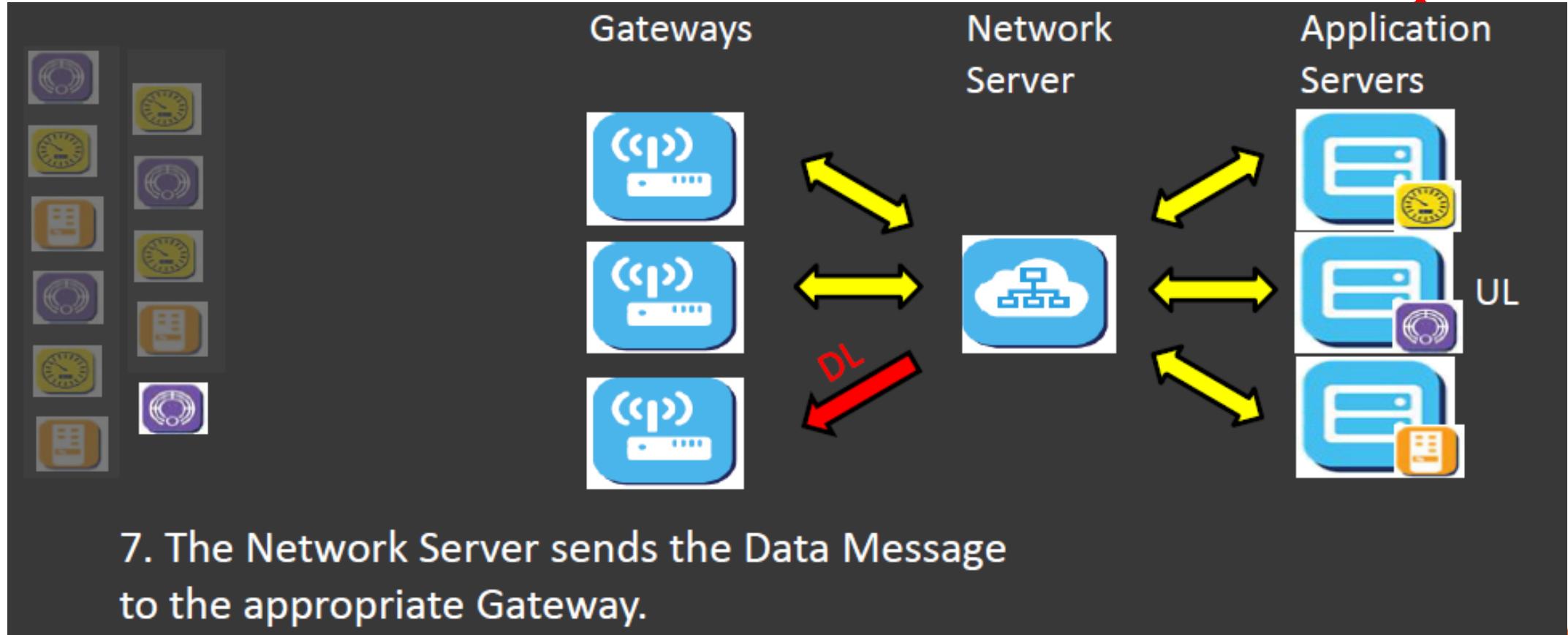
Download & Upload



Ref: LoRa-Aliance.org

Data Message (Flow & Payload)

Download & Upload



Ref: LoRa-Aliance.org

Cayenne Application Server

Type	IPSO	LPP	Hex	Data Size	Data Resolution per bit
Digital Input	3200	0	0	1	1
Digital Output	3201	1	1	1	1
Analog Input	3202	2	2	2	0.01 Signed
Analog Output	3203	3	3	2	0.01 Signed
Illuminance Sensor	3301	101	65	2	1 Lux Unsigned MSB
Presence Sensor	3302	102	66	1	1
Temperature Sensor	3303	103	67	2	0.1 °C Signed MSB
Humidity Sensor	3304	104	68	1	0.5 % Unsigned
Accelerometer	3313	113	71	6	0.001 G Signed MSB per axis
Barometer	3315	115	73	2	0.1 hPa Unsigned MSB
Gyrometer	3334	134	86	6	0.01 °/s Signed MSB per axis
GPS Location	3336	136	88	9	Latitude : 0.0001 ° Signed MSB
					Longitude : 0.0001 ° Signed MSB
					Altitude : 0.01 meter Signed MSB

Ref: <https://mydevices.com/cayenne/docs/lora/>

Cayenne Application Server

Examples

Device with 2 temperature sensors

Payload (Hex)	03 67 01 10 05 67 00 FF	
Data Channel	Type	Value
03 ⇒ 3	67 ⇒ Temperature	0110 = 272 ⇒ 27.2°C
05 ⇒ 5	67 ⇒ Temperature	00FF = 255 ⇒ 25.5°C

Device with temperature and acceleration sensors

Frame N

Payload (Hex)	01 67 FF D7	
Data Channel	Type	Value
01 ⇒ 1	67 ⇒ Temperature	FFD7 = -41 ⇒ -4.1°C

Ref: <https://mydevices.com/cayenne/docs/lora/>

TESA Application Server

Payload Structure

1 Byte	N Byte	1 Byte	M Byte	1 Byte	O Byte	...
Data1 Type	Data1	Data2 Type	Data2	Data3 Type	Data3	...

Data Type

Type	Data Type	Data Type (HEX)	Data Size (Byte)	Data Resolution
Pressure	1	01	2	0.1 hPa Unsigned MSB
Temperature	2	02	2	0.1 °C Signed MSB
Humidity	3	03	2	0.1 % Unsigned
Gyroscope	4	04	6	0.01 °/s Signed MSB per axis
Accelerometer	5	05	6	0.001 G Signed MSB per axis
Magnetometer	6	06	6	1 mGauss Signed MSB per axis
LEDs	7	07	1	1 for each bit
Digital Input 1	8	08	1	1
Digital Input 2	9	09	1	1
Digital Input 3	10	0A	1	1
Digital Input 4	11	0B	1	1
Digital Input 5	12	0C	1	1
Digital Output	160	A0	1	1

TESA Application Server

Examples

Device with temperature and acceleration sensors

Payload (HEX)

02 01 00 05 00 ED 06 07 FE 0C

Data Type	Data
02 => 2 => Temperature	0100 => 256 => 25.6 °C
05 => 5 => Accelerometer	X: 00ED => 237 => 0.231 G
	Y: 0607 => 1543 => 1.543 G
	Z: FE0C => -500 => -0.5 G

LORA BASIC CONCEPT

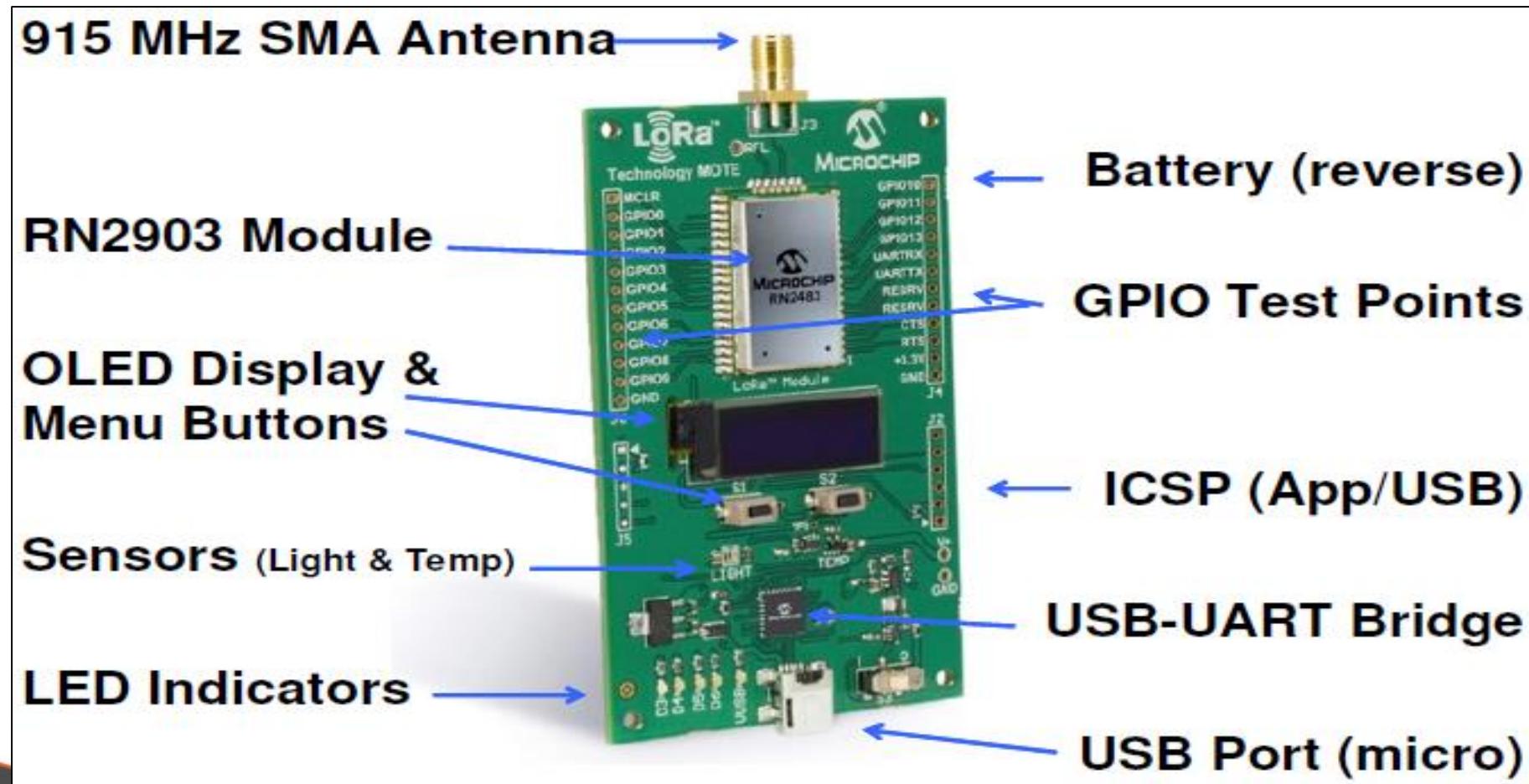
- Frequency
- Channel
- Data Rate
- LoRa Class
- Activation Mode
- Data Message (Flow & Payload)
- Configuration

Configuration

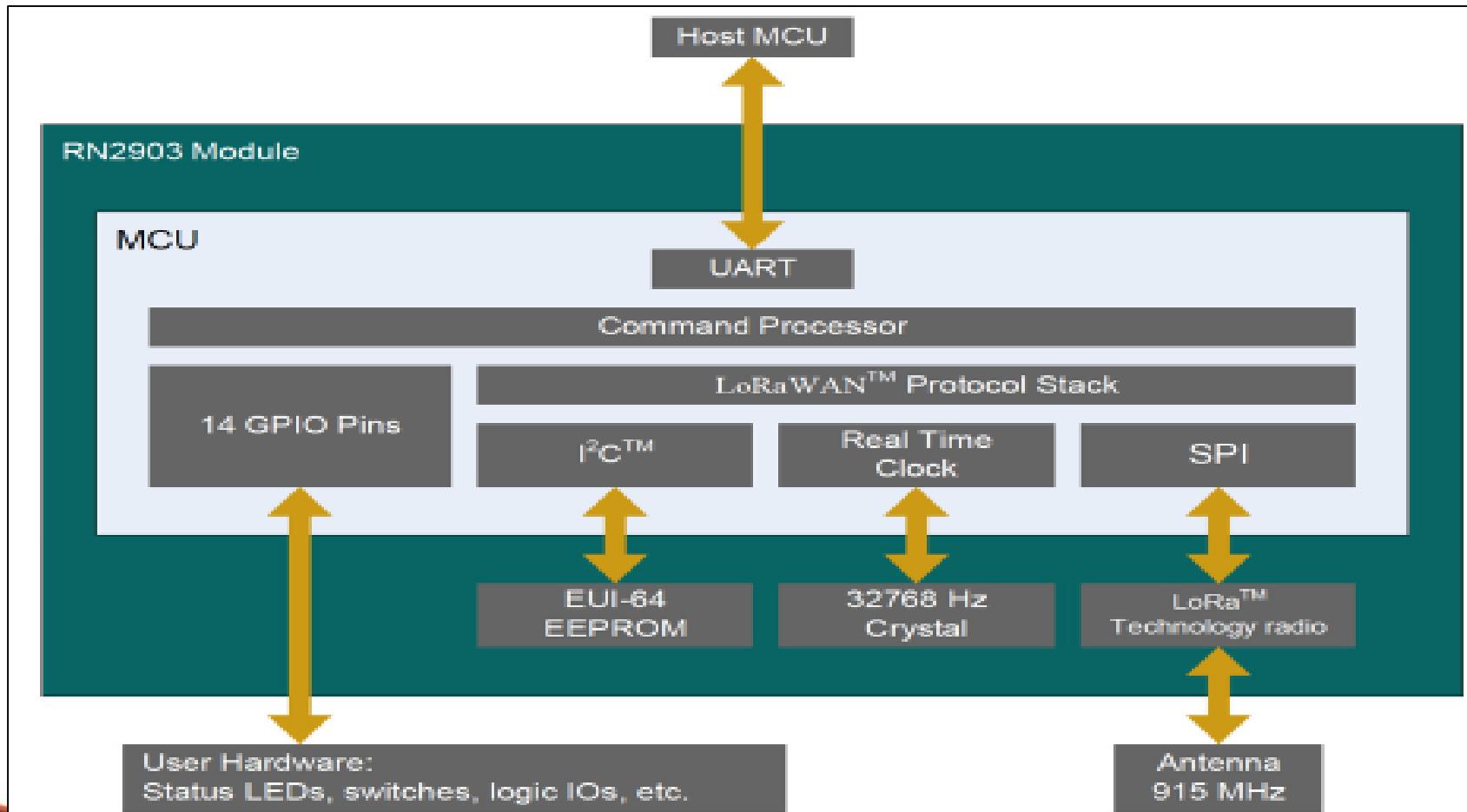


Key	Description
Device EUI (DevEUI)	Unique device ID 64 bit
Device Profile	Refer to Device Class, Frequency and version
Network Key (NwkSKey)	The optional 128-bit key used to encrypt the payload of the messages.
Application Server (AS) Routing Profile	The routing information defining how sensor data is routed to an application back-end connected to the core network platform.
Application Key (AppSKey)	The optional 128-bit key used to encrypt the payload of the messages.

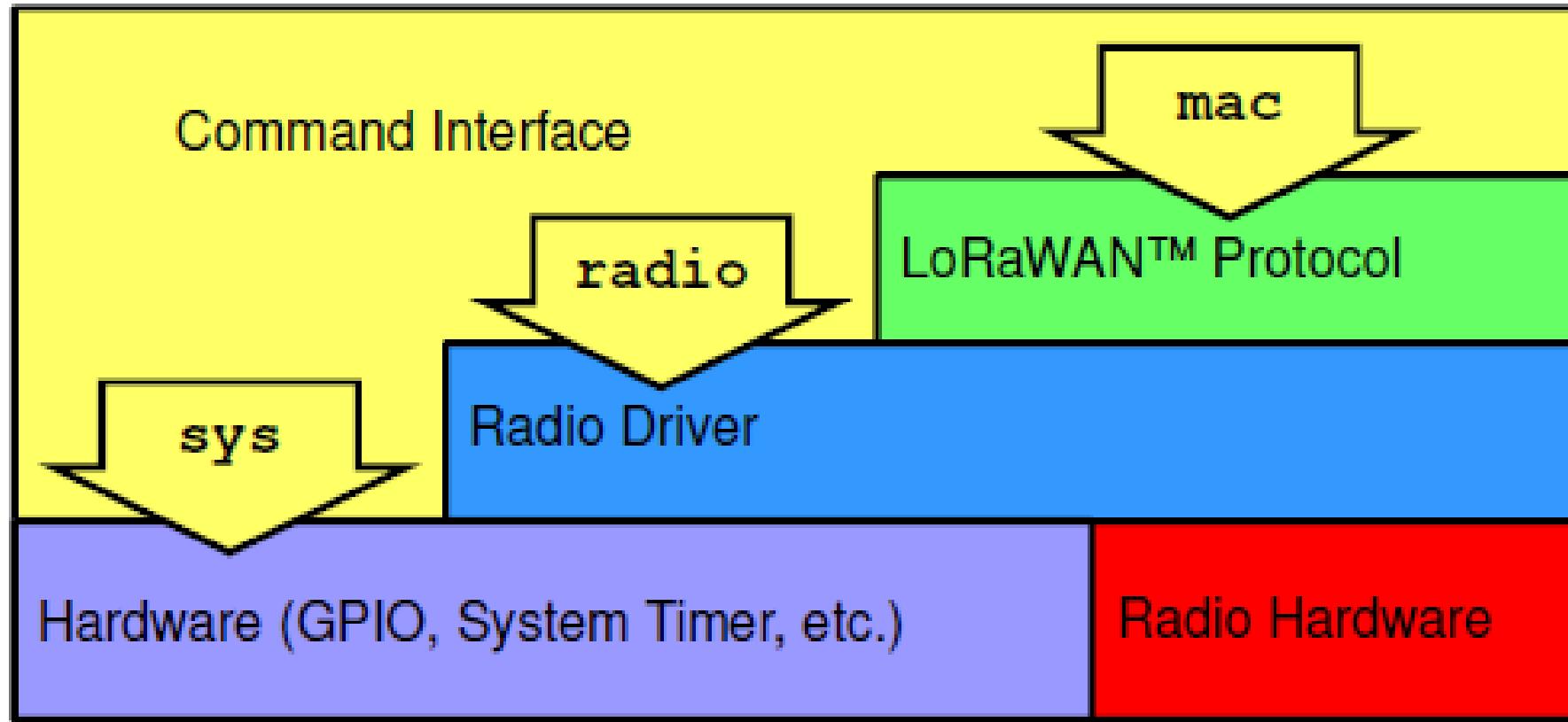
Configuration



Configuration



Configuration



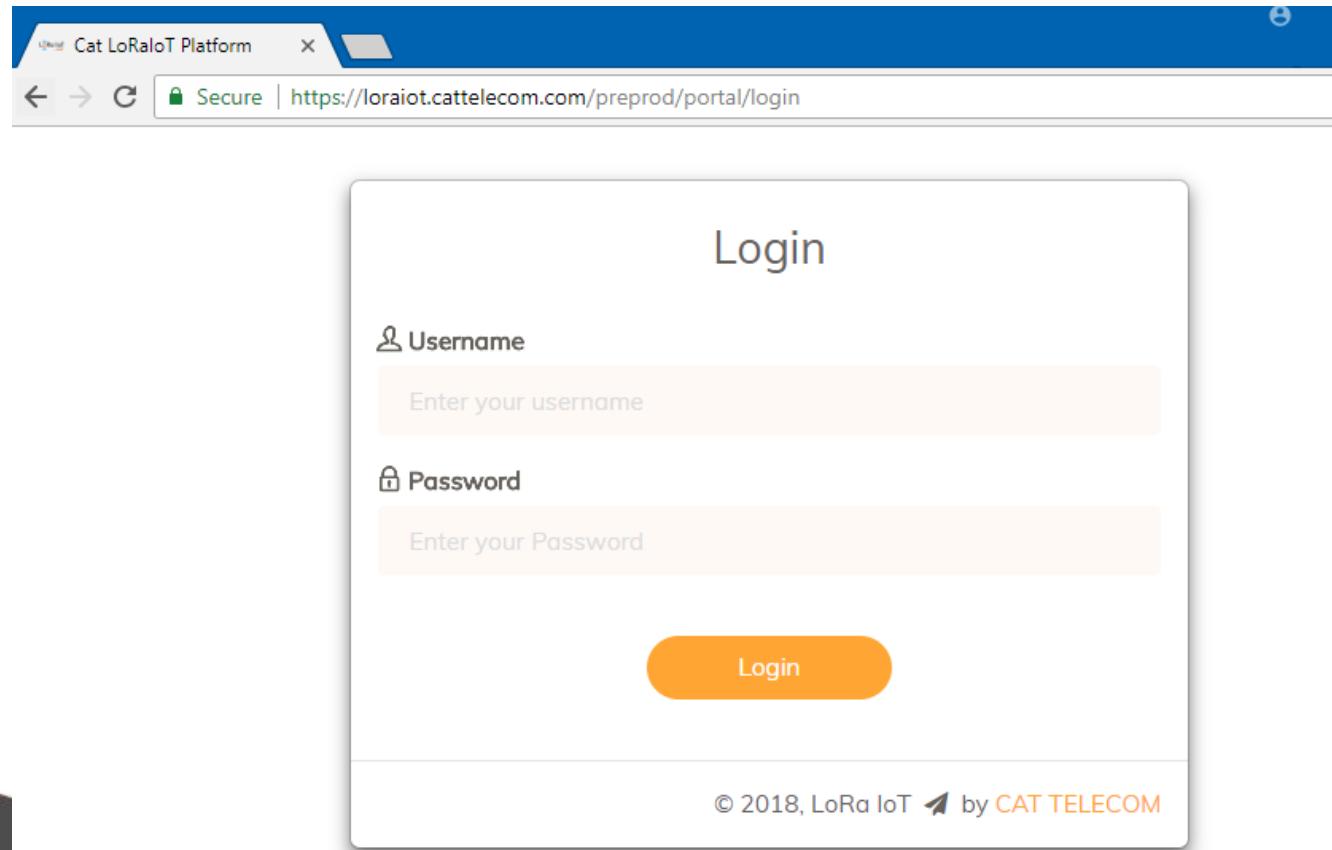
- AT Command**
- mac level
 - radio level
 - sys level

TOPIC

- IoT Concept
- Network Concept
- LoRa Network
- LoRa Basic Concept
- **LoRa Account**
- Device Manager
- Example Application

LoRa Account

<https://loraiot.cattelecom.com/preprod/portal/login>



trainxx เช่น train01

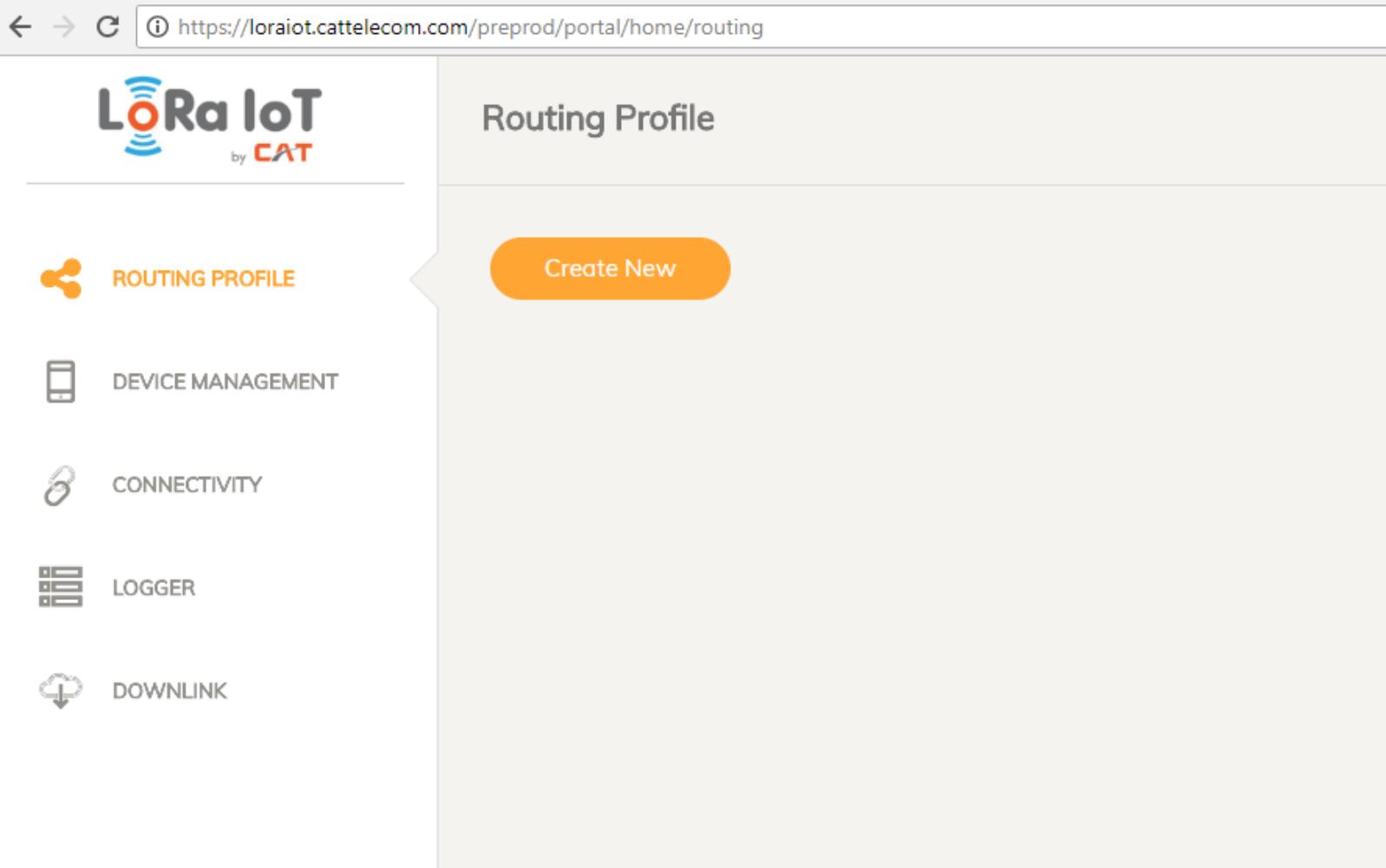
trainxx เช่น train01

TOPIC

- IoT Concept
- Network Concept
- LoRa Network and Basic Concept
- **Workshop : LoRa Account and Device Management**
- Workshop : LoRa Example Application

Device Manager

← → C ⓘ https://loraiot.cattelecom.com/preprod/portal/home/routing



The screenshot shows the 'Routing Profile' section of the LoRa IoT Device Manager. On the left sidebar, there are five menu items: 'ROUTING PROFILE' (selected), 'DEVICE MANAGEMENT', 'CONNECTIVITY', 'LOGGER', and 'DOWNLINK'. The main content area displays the 'Routing Profile' title and a 'Create New' button.

Routing Profile

Device Management

Connectivity

Logger

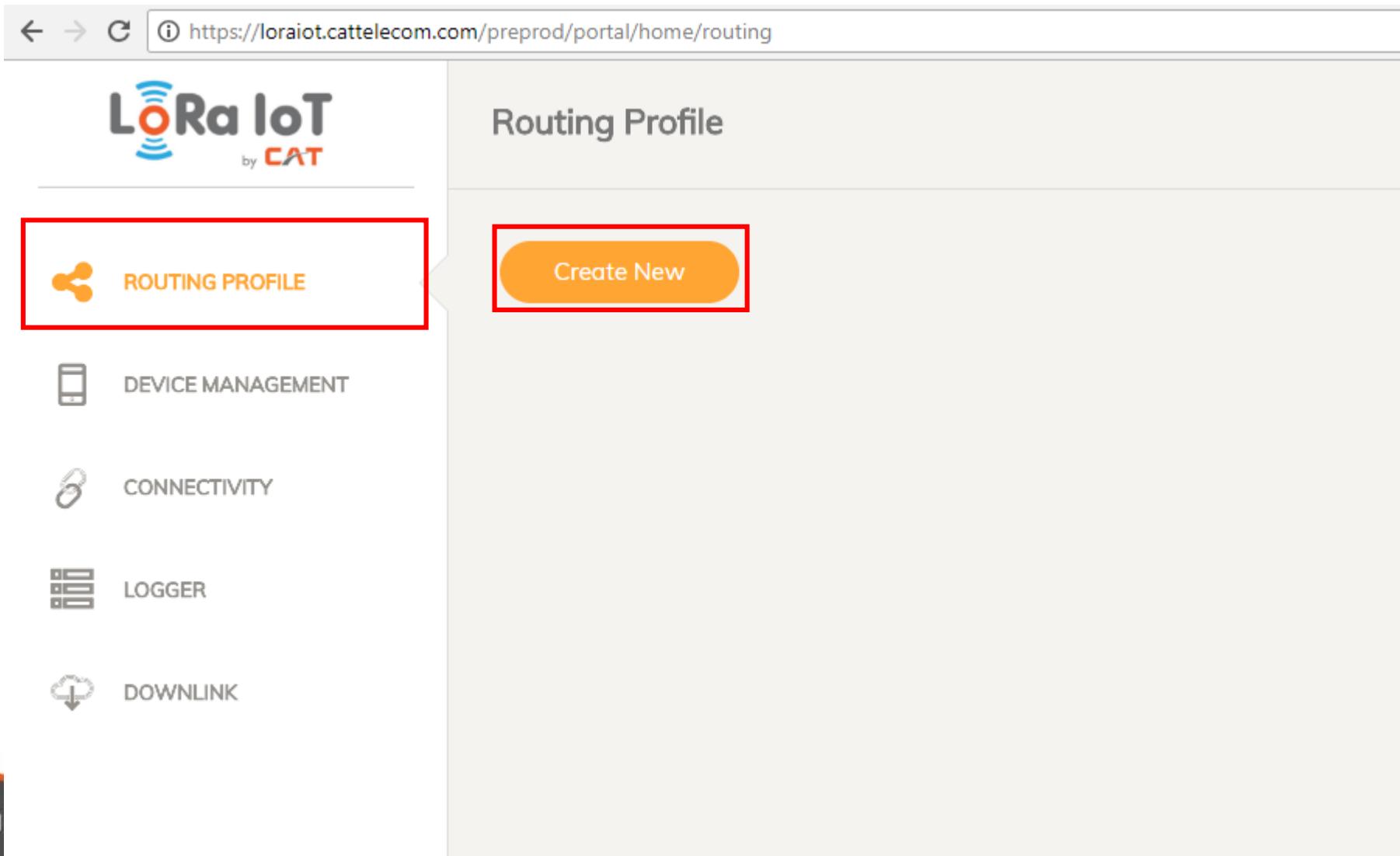
Downlink

Device Manager

Routing Profile

Device Manager

Routing Profile



https://loraiot.cattelecom.com/preprod/portal/home/routing

ROUTING PROFILE

Create New

DEVICE MANAGEMENT

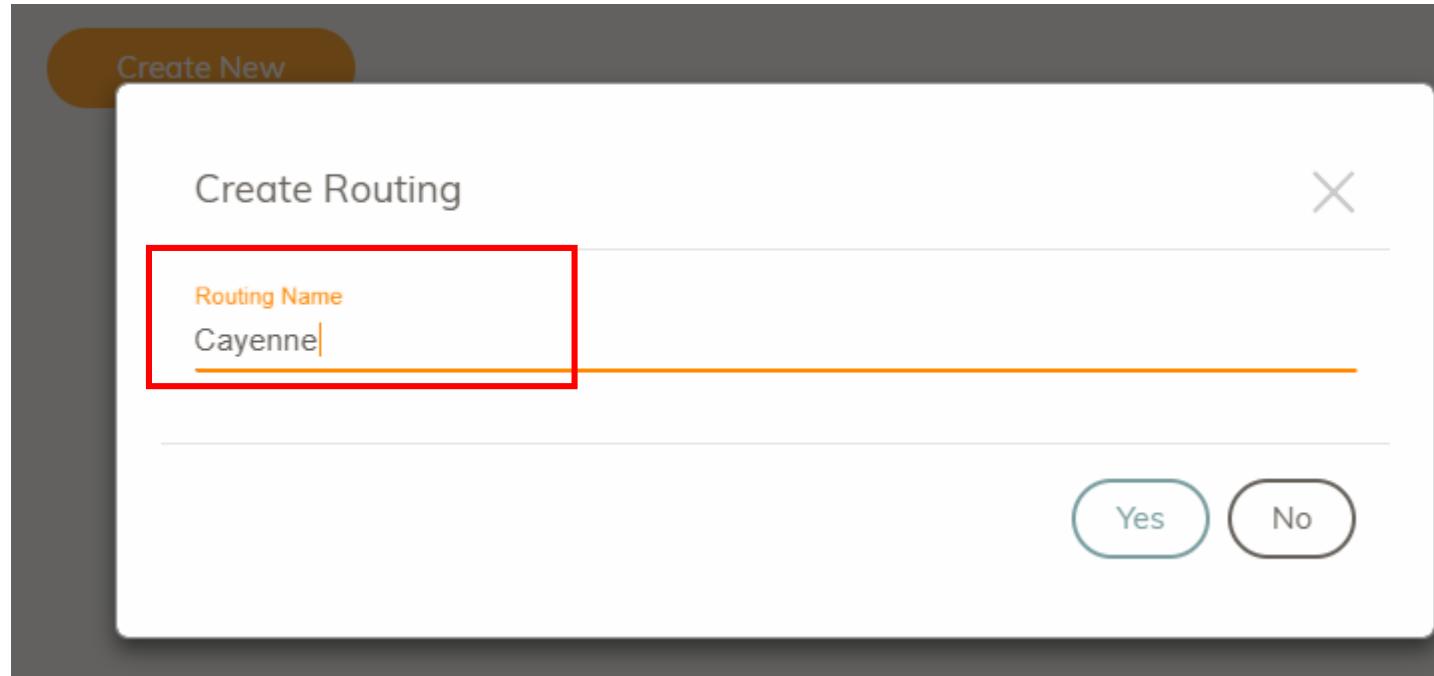
CONNECTIVITY

LOGGER

DOWNLINK

Device Manager

Routing Profile



Device Manager

Routing Profile

Routing Profile

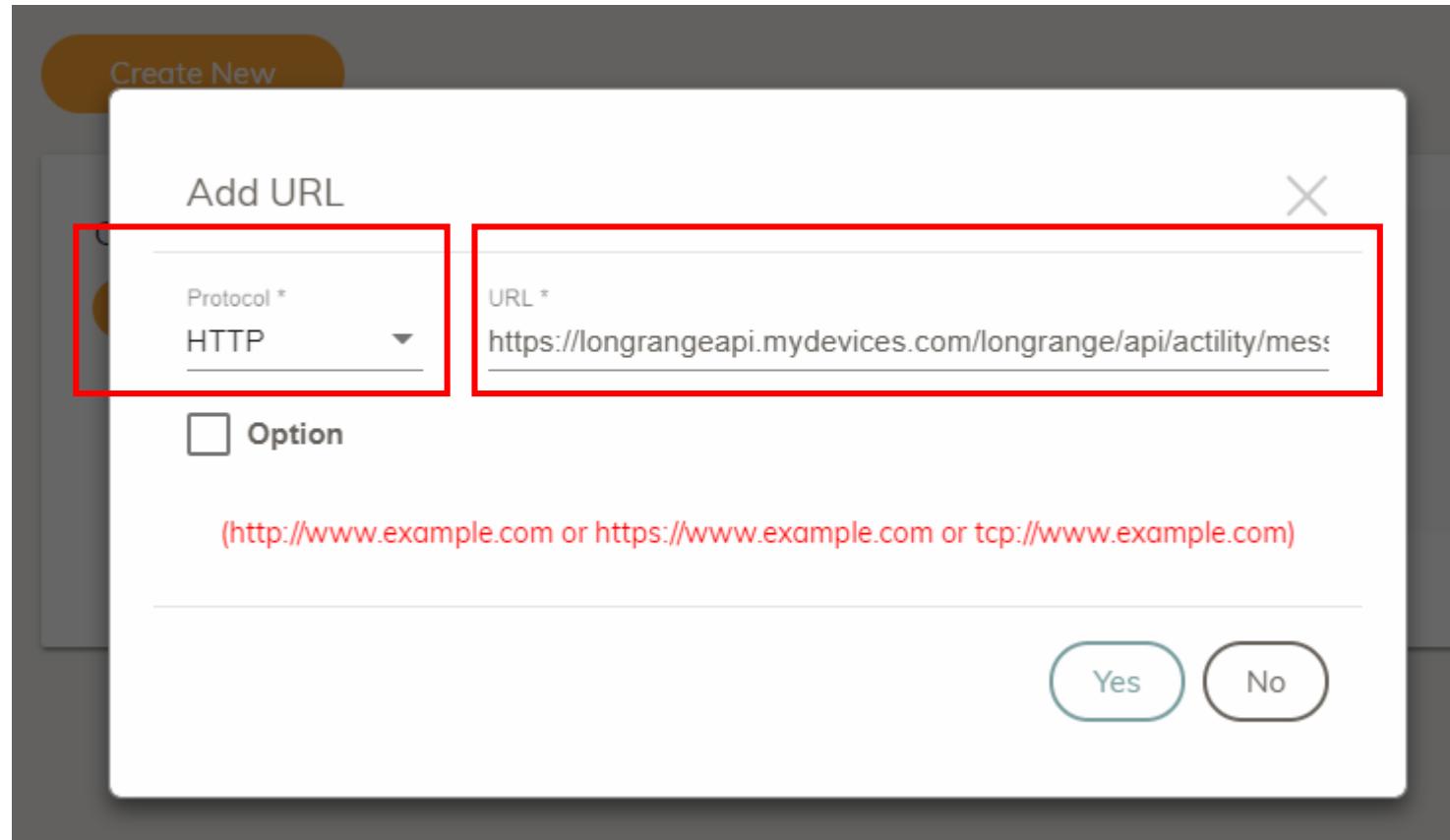
[Create New](#)

Cayenne



Device Manager

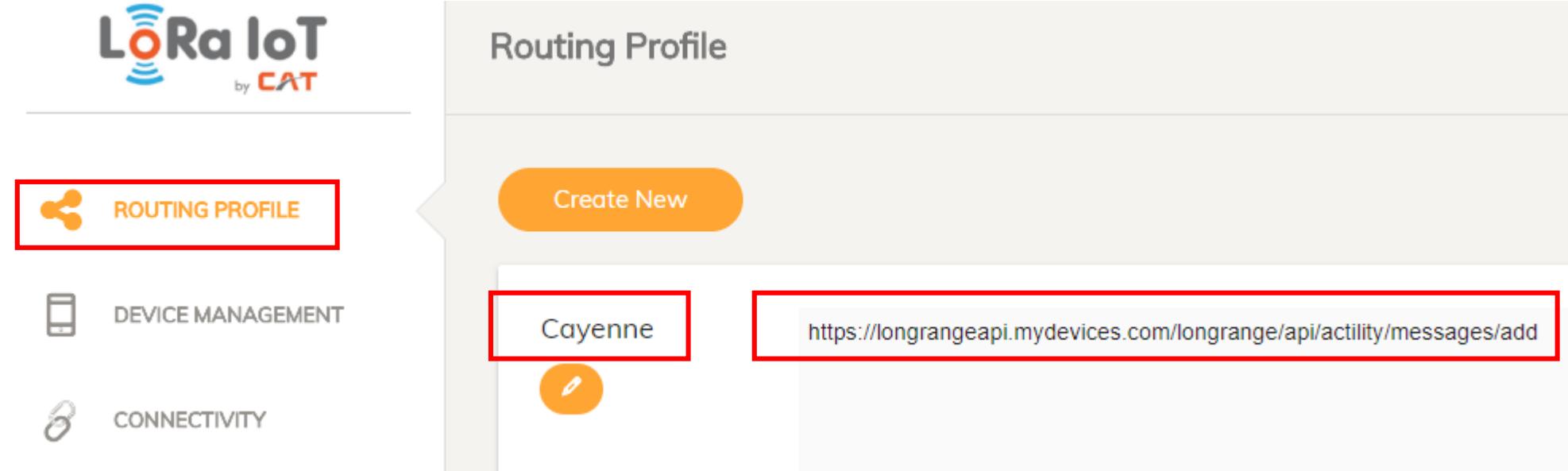
Routing Profile



<https://longrangeapi.mydevices.com/longrange/api/actility/messages/add>

Device Manager

Routing Profile

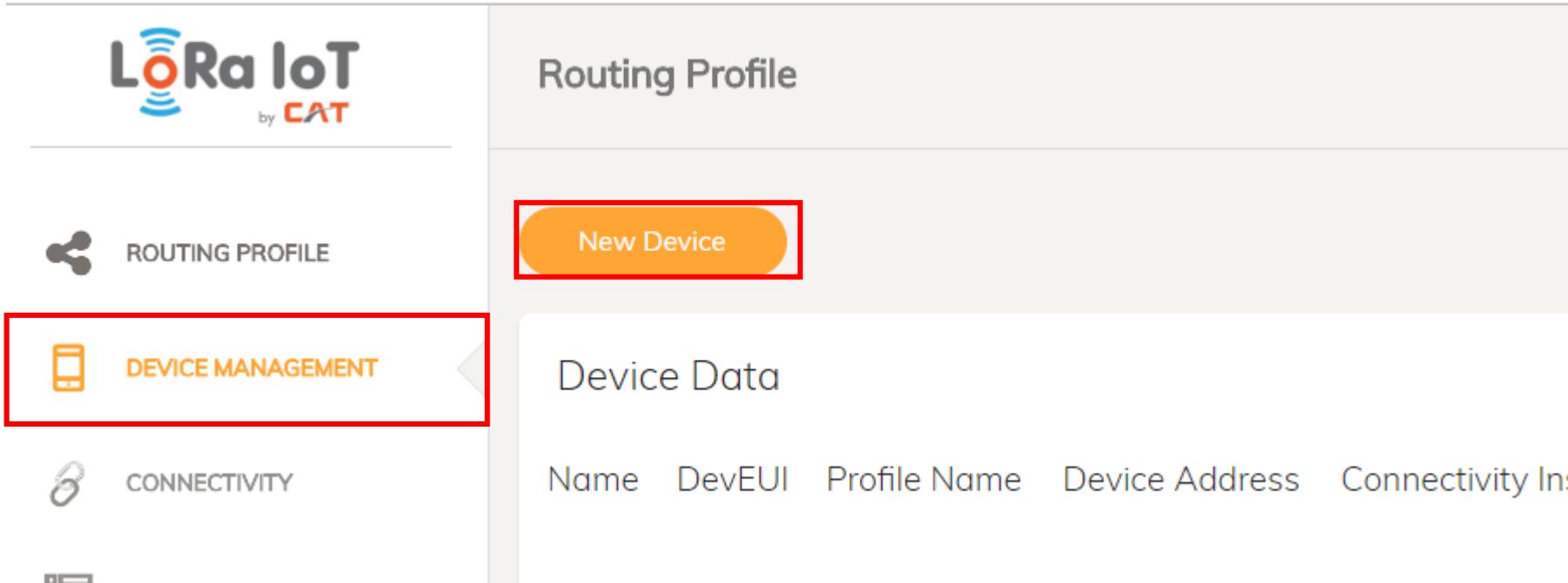


The screenshot shows the LoRa IoT Device Manager interface. On the left, there's a sidebar with three options: 'ROUTING PROFILE' (highlighted with a red border), 'DEVICE MANAGEMENT', and 'CONNECTIVITY'. The main area is titled 'Routing Profile' and contains a 'Create New' button. Below it, there's a list item for 'Cayenne' with a URL: <https://longrangeapi.mydevices.com/longrange/api/actility/messages/add>. A small edit icon is next to the Cayenne entry.

Device Manager

Device Management

Device Manager



The screenshot shows the LoRa IoT Device Manager interface. On the left, there's a vertical navigation bar with four main categories: ROUTING PROFILE, DEVICE MANAGEMENT (which is highlighted with a red box), and CONNECTIVITY. Below these are two smaller, partially visible items. The main content area has a header "Routing Profile" and a prominent orange button labeled "New Device" which is also highlighted with a red box. Below this, under the heading "Device Data", there's a table with columns for Name, DevEUI, Profile Name, Device Address, and Connectivity Inst.

Name	DevEUI	Profile Name	Device Address	Connectivity Inst

Device Manager



Create New Device

* Name : OTAA

Activation Type : **OTAA**

* Device EUI :

* Application EUI :

* Application Key : 0

* Payload Format : Raw

Routing Profile : myserver

* Device Profiles : LoRaWAN Class A - AS923 - Generic

* Connectivity Instances : Preorder (0 / 1) | Exp. 31/12/2019

Yes No

Create New Device

* Name : ABP

Activation Type : **ABP**

* Device EUI :

* Device Address :

* Network Session Key :

* Application Session Key :

* Payload Format : Raw

Routing Profile : myserver

* Device Profiles : LoRaWAN Class A - AS923 - Generic

* Connectivity Instances : Preorder (0 / 1) | Exp. 31/12/2019

Yes No

Device Manager

Device Management

DeviceEUI: AA-00-DB-CA-12-EF-ZZ-XX

DeviceAddr: 12-EF-ZZ-XX

Network Session Key : 28-AE-D2-2B-7E-15-16-A6-09-CF-AB-F7-15-88-4F-3C

Application Session Key: 16-28-AE-2B-7E-15-D2-A6-AB-F7-CF-4F-3C-15-88-09

Create New Device

* Name :

Activation Type :

* Device EUI :

* Device Address :

* Network Session Key :

* Application Session Key :

* Payload Format :

Routing Profile :

* Device Profiles :

* Connectivity Instances :

Device Name *

ABP

ABP

Device EUI (16-character hexadecimal) *

Device Address (8-character hexadecimal) *

Network Session Key (32-character hex) *

Application Session Key (32-character hex) *

Raw

myserver

LoRaWAN Class A - AS923 - Generic

Preorder (0 / 1) | Exp. 31/12/2019

Yes

No

Device Manager

Device Management



 ROUTING PROFILE

 DEVICE MANAGEMENT

 CONNECTIVITY

 LOGGER

 DOWNLINK

Routing Profile

 testworkshop02 

New Device

Device Data

Active	Name	DevEUI	Profile Name	Device Address	Connectivity Instances	Payload Format	Routing Profile	
	940taa	[REDACTED]	LoRaWAN Class A - AS923 - Generic	[REDACTED]	Preorder	Raw	myserver	 
	testabp01	[REDACTED]	LoRaWAN Class A - AS923 - Generic	[REDACTED]	Preorder	Raw	myserver	 
	testabp02	[REDACTED]	LoRaWAN Class A - AS923 - Generic	[REDACTED]	Preorder	Raw	myserver	 

บริษัท กสท โทรคมนาคม จำกัด (มหาชน)

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www.cattelecom.com

CAT CONTACT CENTER | 1322

Device Manager

Connectivity

Device Manager



ROUTING PROFILE

DEVICE MANAGEMENT

CONNECTIVITY

LOGGER

DOWNLINK

Connectivity

3.2.1

3.2.2

Activate Voucher

1111222233334444

Activate

Filter Connectivity

By

Active

Connectivity Data

Start Date

Expire Date

Ref.

Used Connections

Granted Connections

Available

28/05/2018

31/12/2019

Preorder

1

1

No

Device Manager

Logger

Device Manager

Logger



 ROUTING PROFILE

 DEVICE MANAGEMENT

 CONNECTIVITY

 LOGGER

 DOWNLINK

Routing Profile

Filter Device

Device EUI

Search

Logger Data

Timestamp	Device Address	DevEUI	Payload	FPort	FCnt 	FCnt 	RSSI	SNR	SubBand	Channe
18/05/2018 00:40:16	9		0073000001670000026800030064040100	99	360	4	-57.000000	12.000000	G1	LC6
18/05/2018 00:40:11	9		0073000001670000026800030064040100	99	359	3	-60.000000	12.000000	G1	LC7
18/05/2018 00:40:06	9		0073000001670000026800030064040100	99	358	2	-58.000000	11.250000	G1	LC2
18/05/2018 00:40:01	9		0073000001670000026800030064040100	99	357	1	-59.000000	11.500000	G1	LC3

Device Manager

Downlink

Device Manager



ROUTING PROFILE

DEVICE MANAGEMENT

CONNECTIVITY

LOGGER

DOWNLINK

Routing Profile

Test Downlink

Downlink API

Input Data

Device EUI

Payload

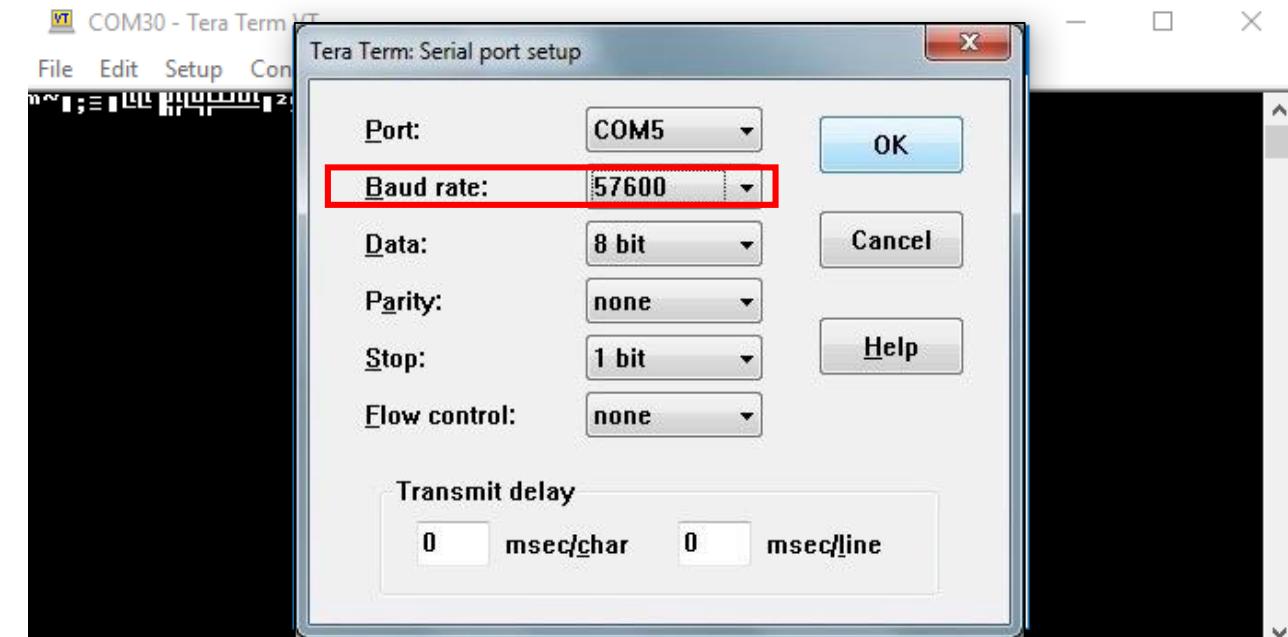
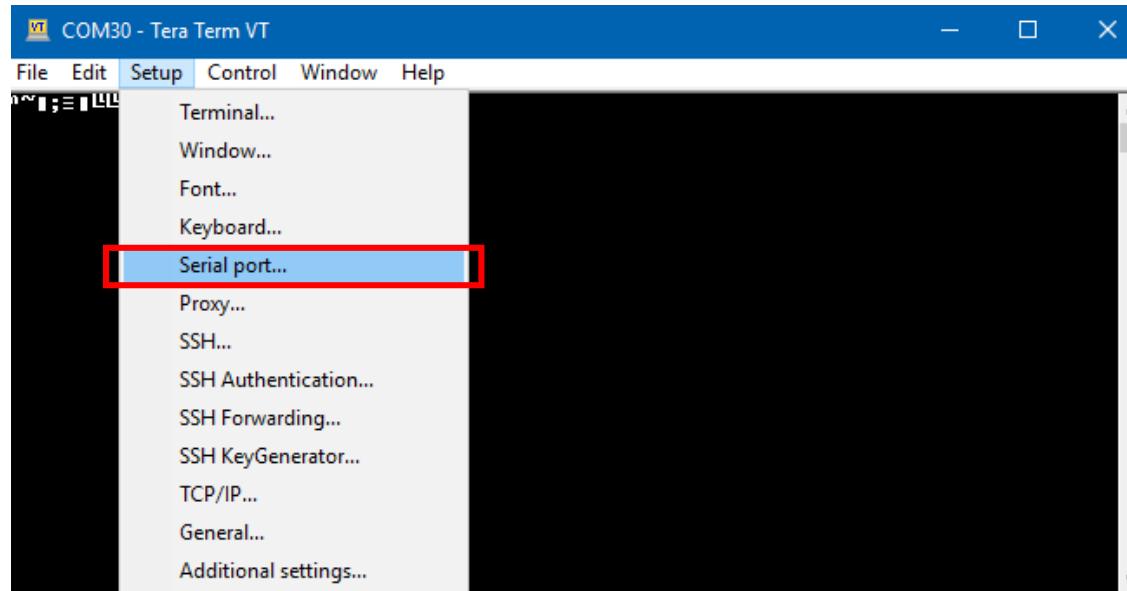
Target Port

Send Payload

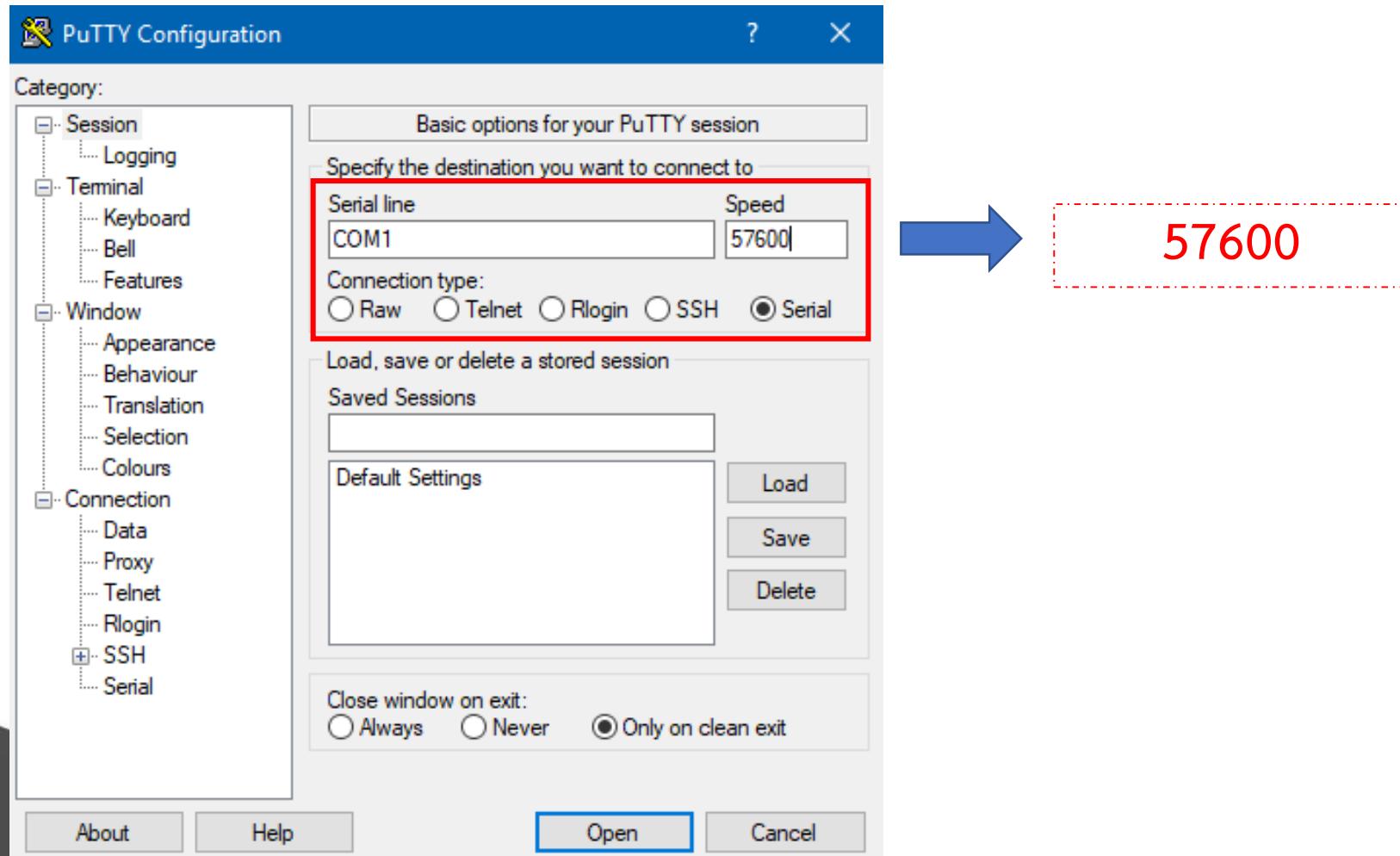
Response

Response Message

Get Device EUI and Address From Node



Get Device EUI and Address From Node



Device Manager

Activation Mode	OTAA	ABP
Device EUI	O	O
Device Address	X	O
Network Session Key	X	O
Application Session Key	X	O
Application EUI	O	X
Application Key	O	X

อ่านค่า ID ของอุปกรณ์โดยใช้คำสั่ง sys get hweui

< sys get hweui
> 0004A30B001B78E4

ค่า hweui ที่อ่านได้จากอุปกรณ์นั้นๆ 0000000000000000

ค่า hweui ในส่วนของ 8 หลักหลัง 00000000

28-AE-D2-2B-7E-15-16-A6-09-CF-AB-F7-15-88-4F-3C

16-28-AE-2B-7E-15-D2-A6-AB-F7-CF-4F-3C-15-88-09

16-28-AE-2B-7E-15-D2-A6-AB

16-28-AE-2B-7E-15-D2-A6-AB-F7-CF-4F-3C-15-88-09

Device Manager

ตัวอย่างการเชื่อมต่อด้วย โหมด OTAA



ใช้ค่า Key ให้ตรงกับที่กรอกใน <https://loraiot.cattelecom.com/portal/>

< mac set deveui 0000000000000000

// ค่า hweui ที่อ่านได้จากอุปกรณ์นั้นๆ

< mac set appeui 1628AE2B7E15D2A6

< mac set appkey 1628AE2B7E15D2A6ABF7CF4F3C158809

< mac save

ทดสอบโดย ลองเชื่อมต่อ (Join) ถ้าสามารถเชื่อมต่อสำเร็จจะขึ้น accepted

> mac join otaa

< ok

< accepted

Device Manager

ตัวอย่างการเชื่อมต่อด้วย โหมด ABP



ใช้ค่า Key ให้ตรงกับที่กรอกใน <https://loraiot.cattelecom.com/portal/>

< mac set deveui 0000000000000000

// ค่า hweui ที่อ่านได้จากอุปกรณ์นั้นๆ

< mac set devaddr 00000000

// ค่า hweui 8 หลักหลัง

< mac set nwkskey 28AED22B7E1516A609CFABF715884F3C

< mac set appskey 1628AE2B7E15D2A6ABF7CF4F3C158809

< mac save

ทดสอบโดย ลองเชื่อมต่อ (Join) ถ้าสามารถเชื่อมต่อสำเร็จจะขึ้น accepted

> mac join otaa

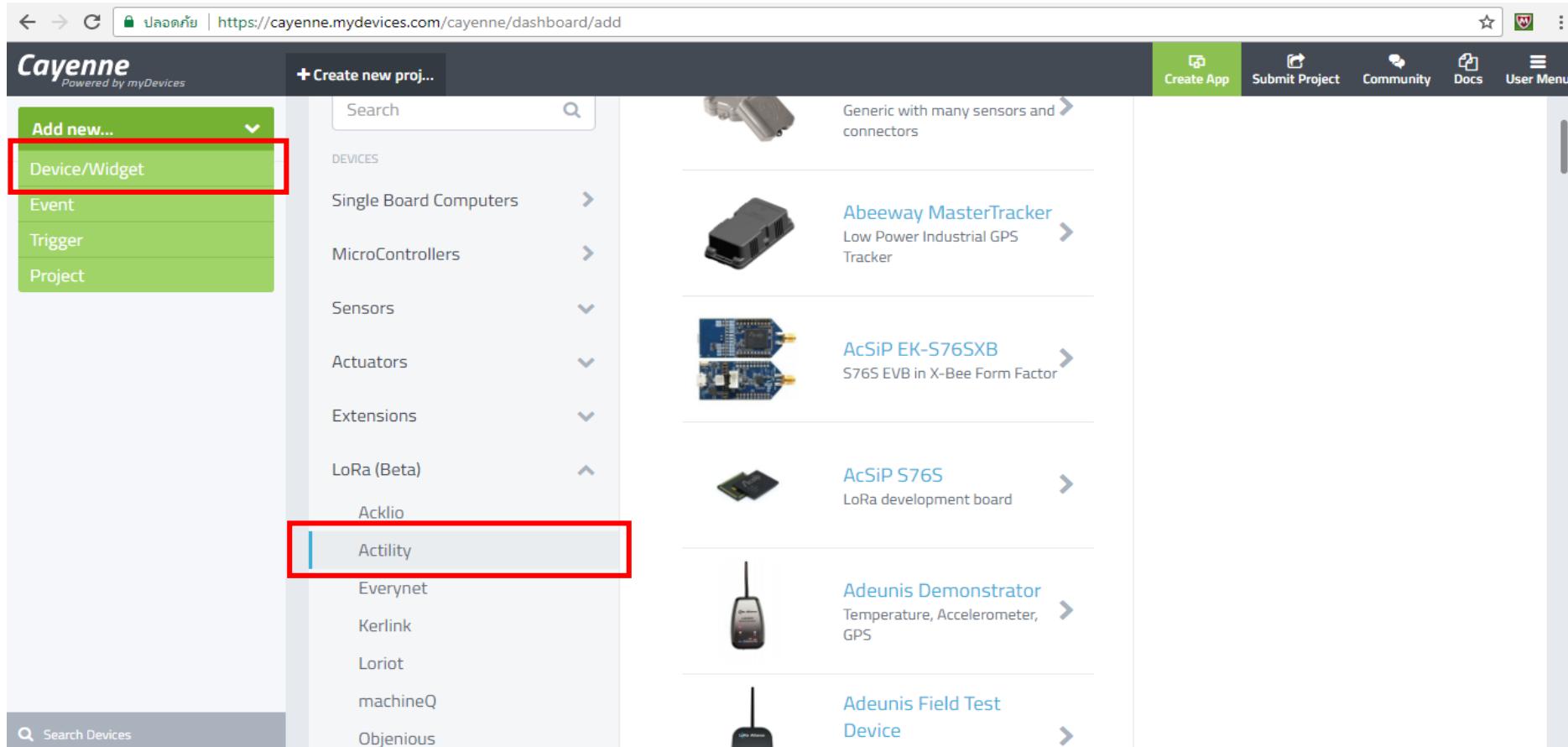
< ok

< accepted

TOPIC

- IoT Concept
- Network Concept
- LoRa Network and Basic Concept
- Workshop : LoRa Account and Device Management
- **Workshop : LoRa Example Application**

Example Application



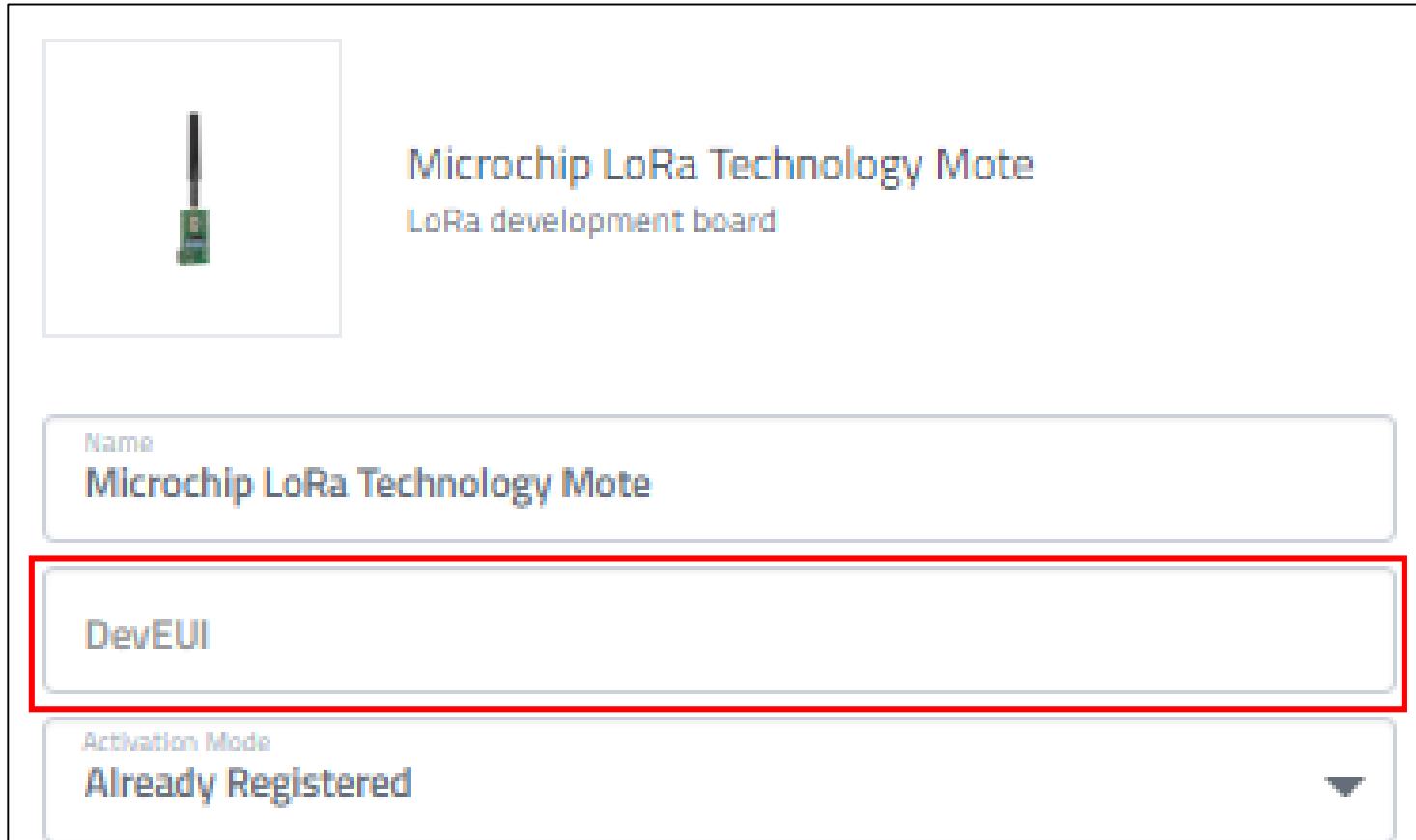
The screenshot shows the Cayenne dashboard creation interface. On the left, a sidebar has a dropdown menu with options: 'Add new...', 'Device/Widget' (highlighted with a red box), 'Event', 'Trigger', and 'Project'. Below this, under 'Acklio', the 'Acklio' option is also highlighted with a red box. The main area lists various device categories and specific device models with their descriptions and images.

- Generic with many sensors and connectors
- Abeeway MasterTracker
Low Power Industrial GPS Tracker
- AcSiP EK-S76SXB
S76S EVB in X-Bee Form Factor
- AcSiP S76S
LoRa development board
- Adeunis Demonstrator
Temperature, Accelerometer, GPS
- Adeunis Field Test Device

Search Devices

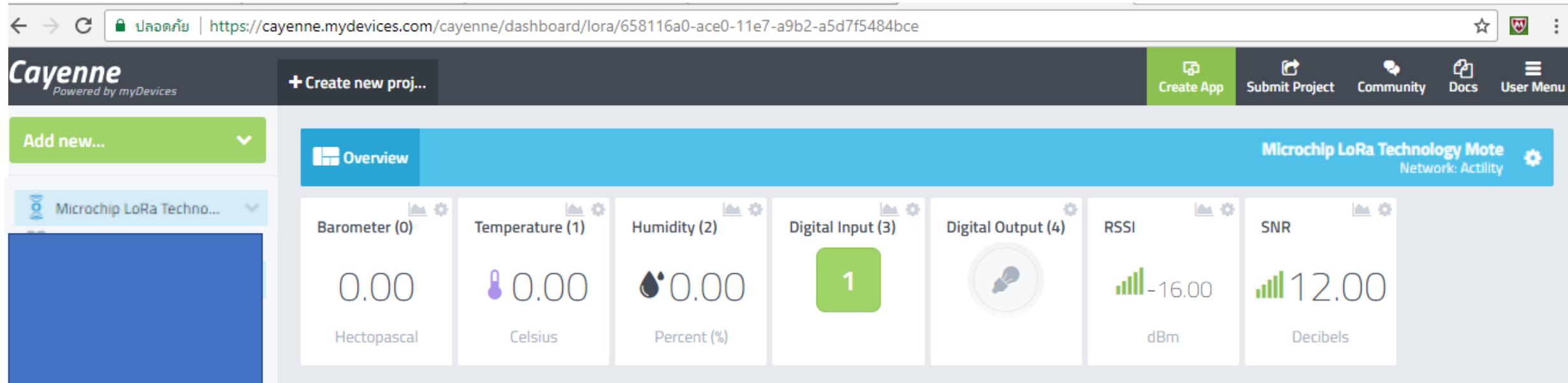
<https://cayenne.mydevices.com/cayenne/dashboard/add>

Example Application



<https://cayenne.mydevices.com/cayenne/dashboard/add>

Example Application



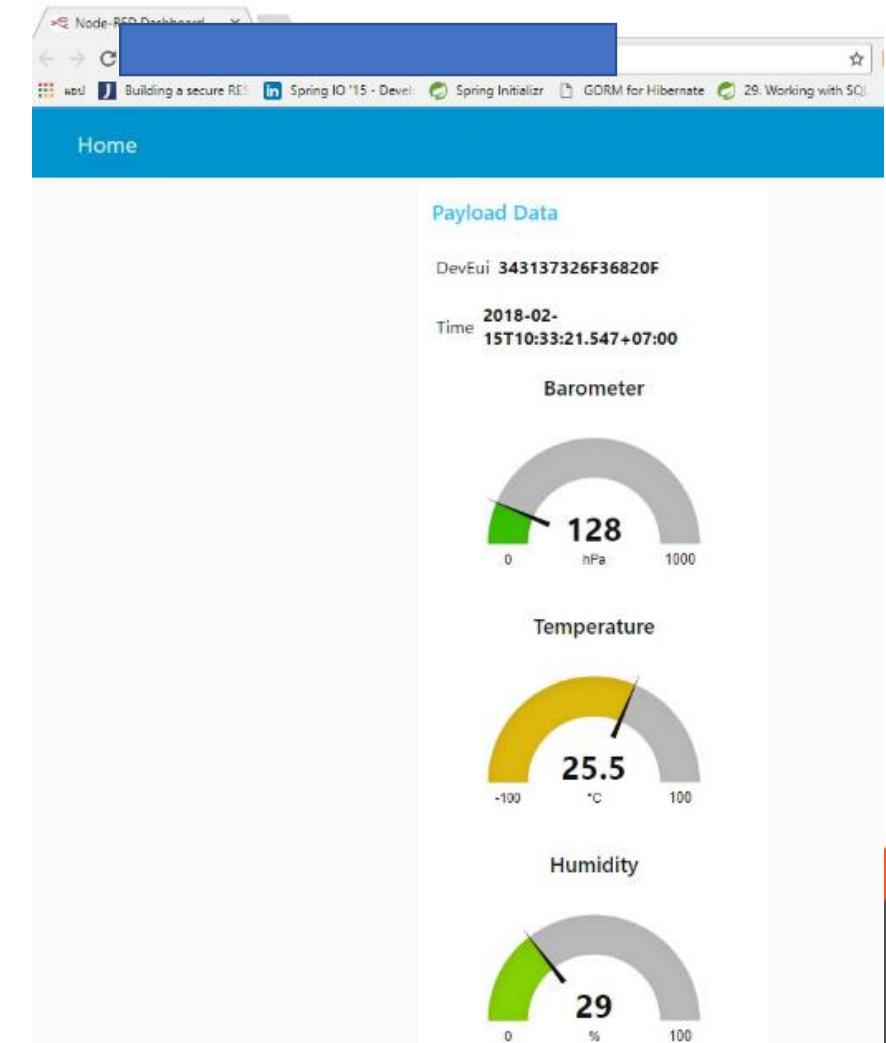
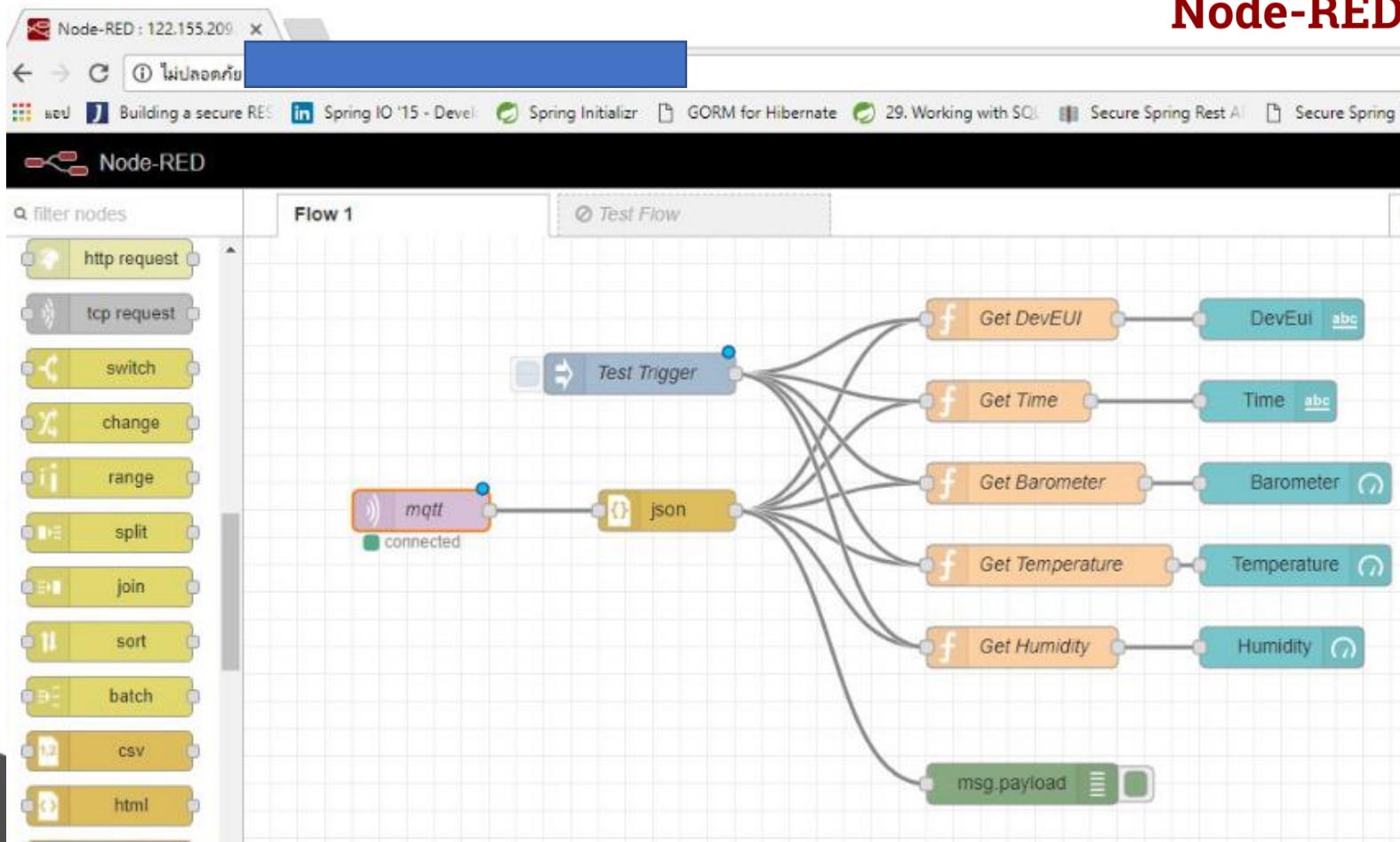
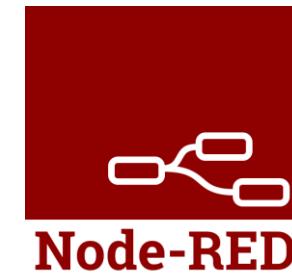
The screenshot shows the Cayenne IoT dashboard interface. At the top, there's a navigation bar with links for 'Create new proj...', 'Create App', 'Submit Project', 'Community', 'Docs', and 'User Menu'. On the left, a sidebar has a dropdown menu 'Add new...' and a section titled 'Microchip LoRa Techno...'. The main area is titled 'Overview' and displays seven data cards:

- Barometer (0)**: Value 0.00 Hectopascal
- Temperature (1)**: Value 0.00 Celsius
- Humidity (2)**: Value 0.00 Percent (%)
- Digital Input (3)**: Value 1 (indicated by a green button)
- Digital Output (4)**: Indicated by a lightbulb icon
- RSSI**: Value -16.00 dBm
- SNR**: Value 12.00 Decibels

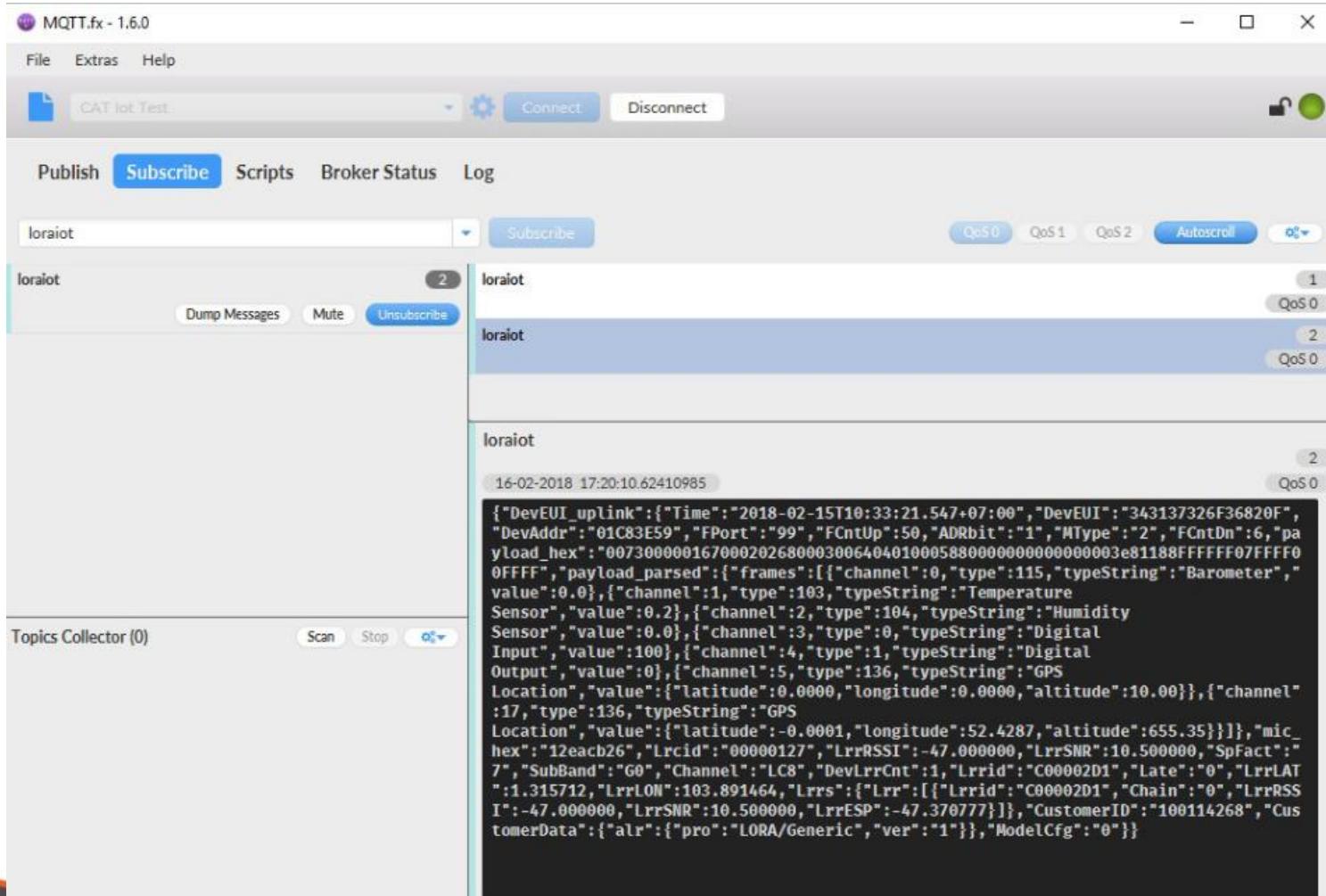
In the top right corner of the dashboard, it says 'Microchip LoRa Technology Mote' and 'Network: Actility'.

<https://cayenne.mydevices.com/cayenne/dashboard/add>

Example Application



Example Application





Q&A