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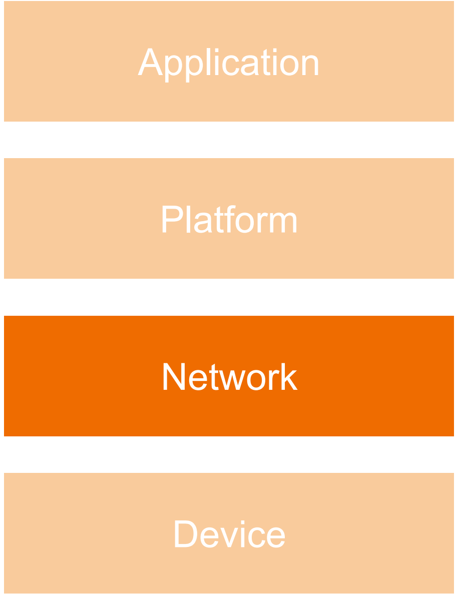
ANTARES

LoRa & LoRaWAN Connectivity

Fariz Alemuda

IoT Stack



Application

Platform

Network

Device

IoT Network

LoRaWAN®

Wi Fi™

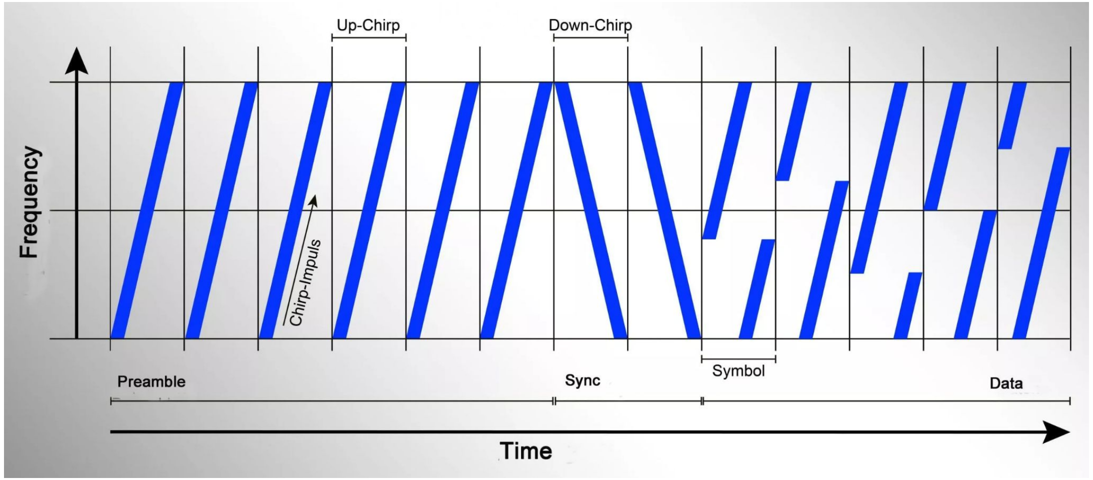
NB-IoT™

5G

Apa itu LoRa & LoRaWAN?

LoRa vs LoRaWAN

LoRa adalah sebuah teknologi modulasi berbasis Chirp Spread Spectrum (CSS) technology. CSS mengirimkan informasi via gelombang radio yang “menanjak tajam” atau “menukik tajam”, mirip dengan modulasi komunikasi yang digunakan lumba-lumba dan kelelawar

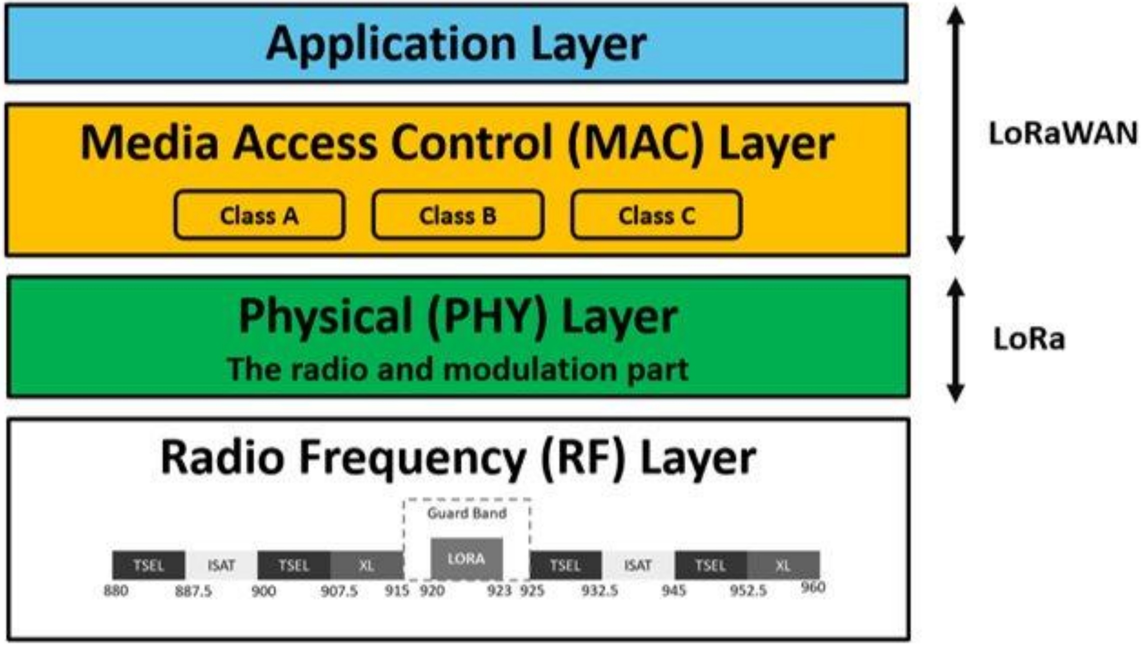


LoRa vs LoRaWAN

LoRaWAN adalah Media Access Control (MAC) layer protocol yang dibuat berbasis protokol modulasi LoRa. LoRaWAN merupakan software layer yang membantu mengatur device management, security, schedule pengiriman, format data, dll.

The LoRaWAN protocol dibuat dan dikembangkan oleh LoRa Alliance.

LoRa vs LoRaWAN

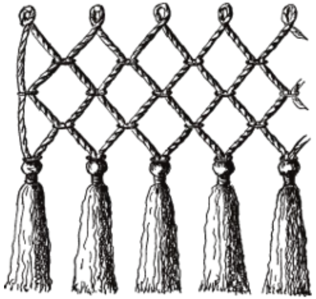


LoRa vs LoRaWAN

LoRa

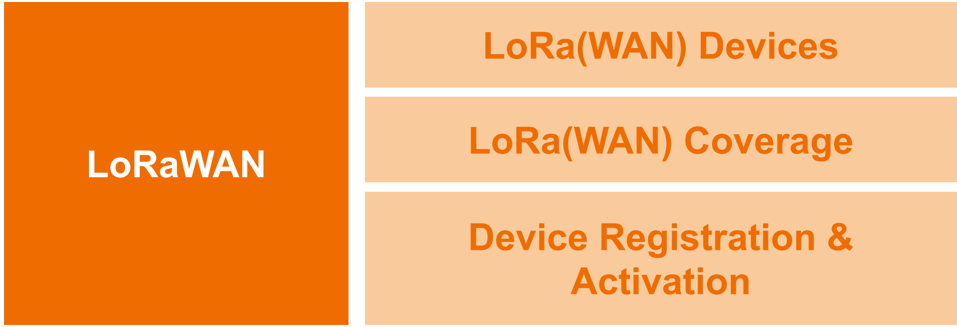
Tali

LoRaWAN



Jaring

How to Connect?



LoRaWAN

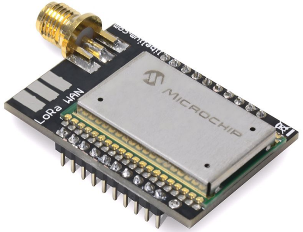
LoRa(WAN) Devices

LoRa(WAN) Coverage

Device Registration & Activation

LoRaWAN Device

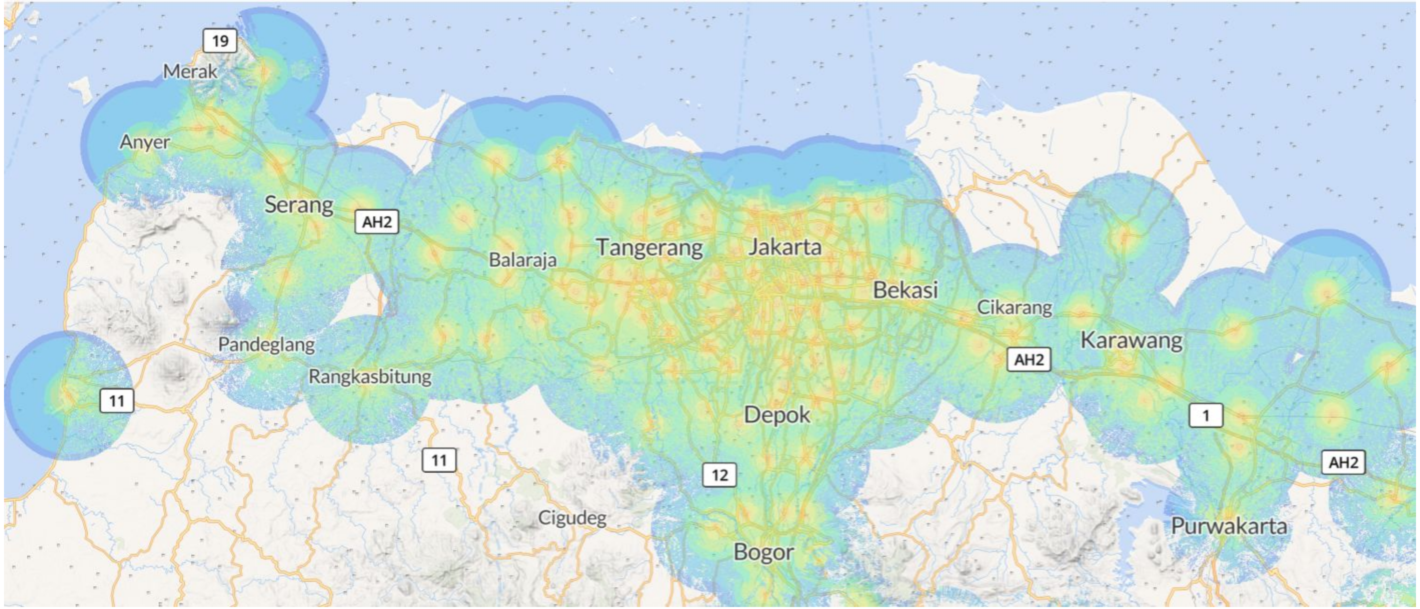
Chipsets Option



RFM95W

- LoRaTM Modem.
- 168 dB maximum link budget.
- +20 dBm - 100 mW constant RF output vs. V supply.
- +14 dBm high efficiency PA.
- Programmable bit rate up to 300 kbps.
- High sensitivity: down to -148 dBm.
- Bullet-proof front end: IIP3 = -12.5 dBm.
- Excellent blocking immunity.
- Low RX current of 10.3 mA, 200 nA register retention.
- Fully integrated synthesizer with a resolution of 61 Hz.
- FSK, GFSK, MSK, GMSK, LoRaTM and OOK modulation.
- Built-in bit synchronizer for clock recovery.
- Preamble detection.
- 127 dB Dynamic Range RSSI.
- Automatic RF Sense and CAD with ultra-fast AFC.
- Packet engine up to 256 bytes with CRC.
- Built-in temperature sensor and low battery indicator.
- Module Size : 16*16mm

Coverage ANTARES Connectivity LoRaWAN

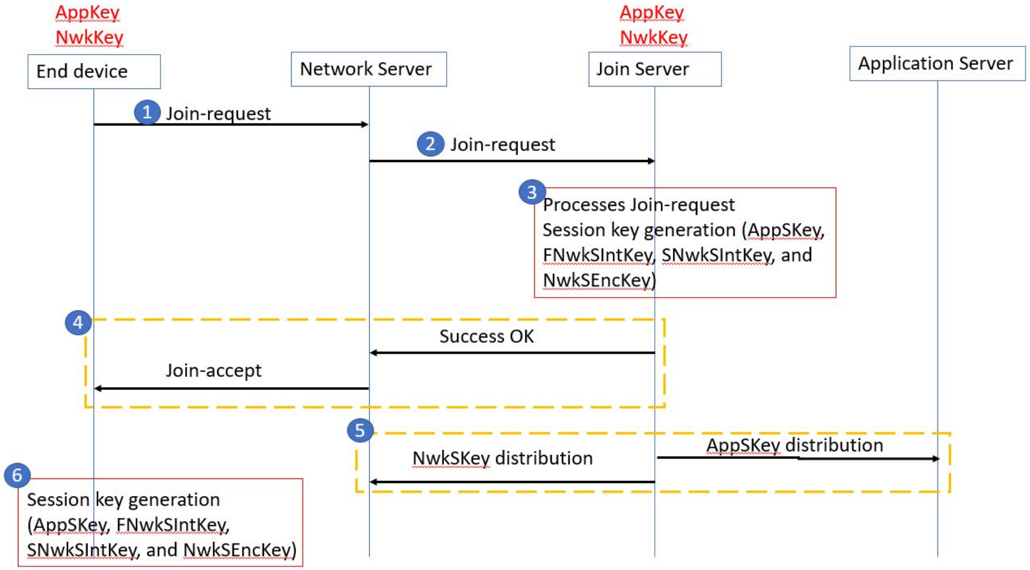


https://www.telkomiot.com/coverage

Device Activation LoRaWAN

- **Over-The-Air-Activation (OTAA)** - metode aktivasi paling aman dan rekomen bagi end-device. Perangkat akan melakukan join procedure sebelum bisa berkomunikasi dengan Network Server sehingga device address dan security key bersifat dinamis.
- **Activation By Personalization (ABP)** - metode aktivasi yang memaksa device menyimpan device address dan parameter security lainnya sehingga membuat metode ini lebih tidak secure dibandingkan OTAA dan device harus dikonfigurasi secara non-remote.

Device Activation LoRaWAN OTAA



AppKey
NwkKey

End device

Network Server

AppKey
NwkKey

Join Server

Application Server

1 Join-request

2 Join-request

3 Processes Join-request
Session key generation (AppSKey, FNwkSIntKey, SNwkSIntKey, and NwkSEncKey)

4 Success OK

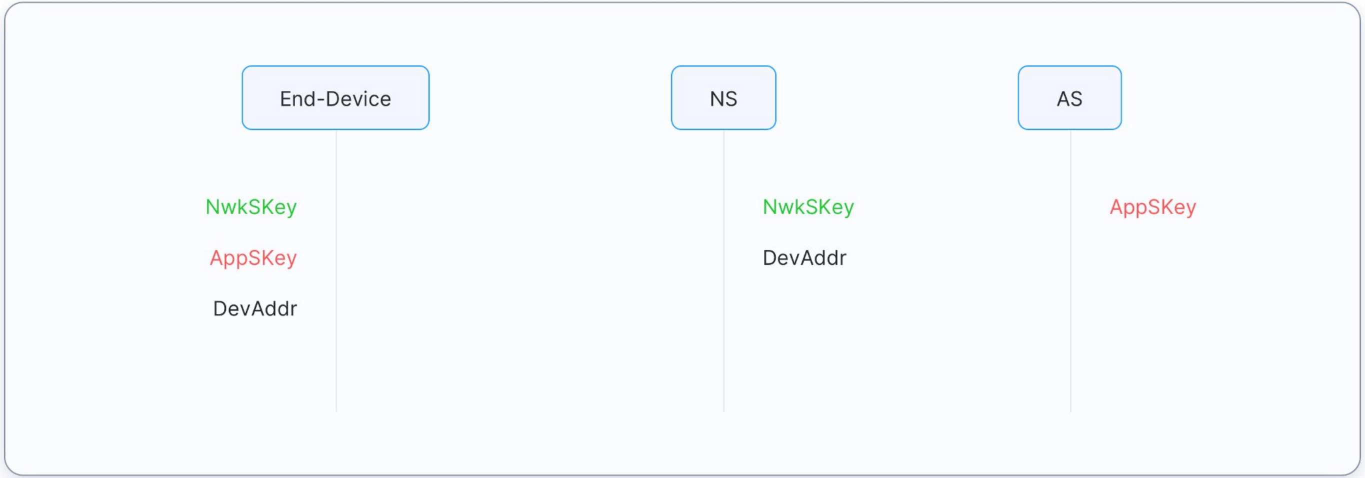
Join-accept

5 AppSKey distribution

NwkSKey distribution

6 Session key generation (AppSKey, FNwkSIntKey, SNwkSIntKey, and NwkSEncKey)

Device Activation LoRaWAN
ABP



End-Device

NwkSKey

AppSKey

DevAddr

NS

NwkSKey

DevAddr

AS

AppSKey

Let’s Do Some Hands-On

Sesi Hands-On LoRaWAN

1 Kirim Data Dummy ke ANTARES

2 Kirim Data Sensor Environment ke ANTARES

3 Kirim Data LDR di ANTARES

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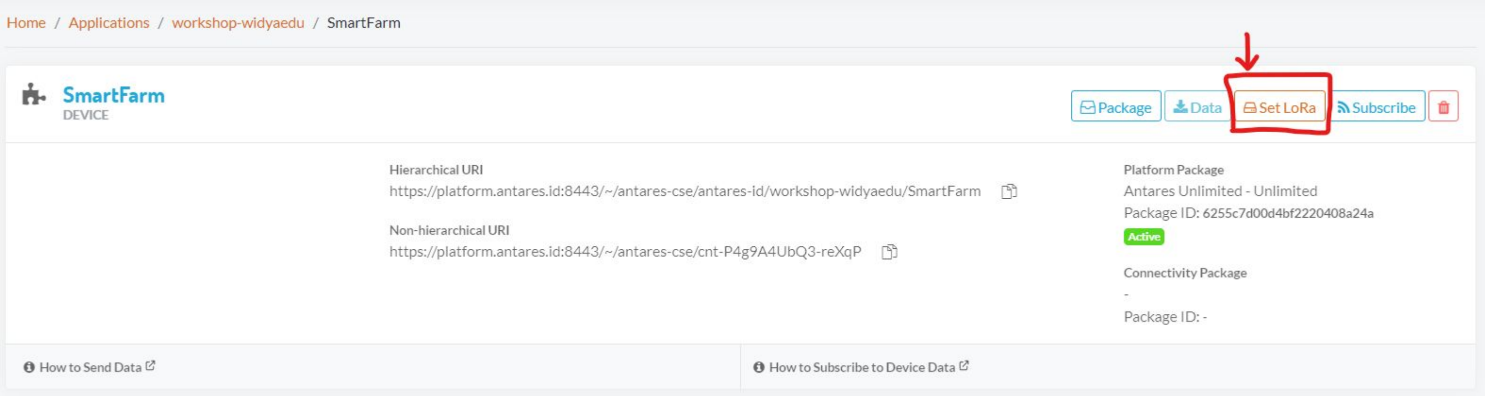
Mengirimkan Data Dummy via LoRaWAN

Registrasi & Aktivasi Device LoRa



Home / Applications / workshop-widyaedu / SmartFarm

SmartFarm
DEVICE

Hierarchical URI
https://platform.antares.id:8443/~/antares-cse/antares-id/workshop-widyaedu/SmartFarm

Non-hierarchical URI
https://platform.antares.id:8443/~/antares-cse/cnt-P4g9A4UbQ3-reXqP

Platform Package
Antares Unlimited - Unlimited
Package ID: 6255c7d00d4bf2220408a24a
Active

Connectivity Package
-
Package ID: -

How to Send Data

How to Subscribe to Device Data

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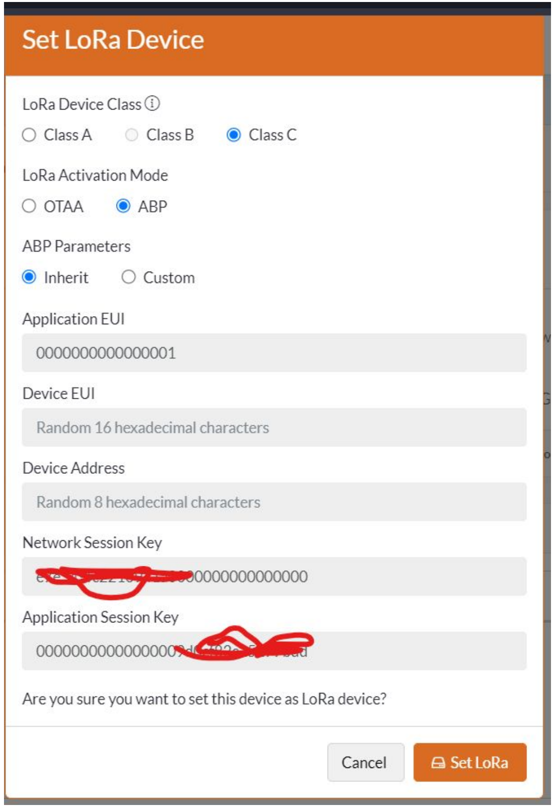
Registrasi & Aktivasi Device LoRa



Set LoRa Device

LoRa Device Class ⓘ

○ Class A ○ Class B ● Class C

LoRa Activation Mode

○ OTAA ● ABP

ABP Parameters

● Inherit ○ Custom

Application EUI

0000000000000001

Device EUI

Random 16 hexadecimal characters

Device Address

Random 8 hexadecimal characters

Network Session Key

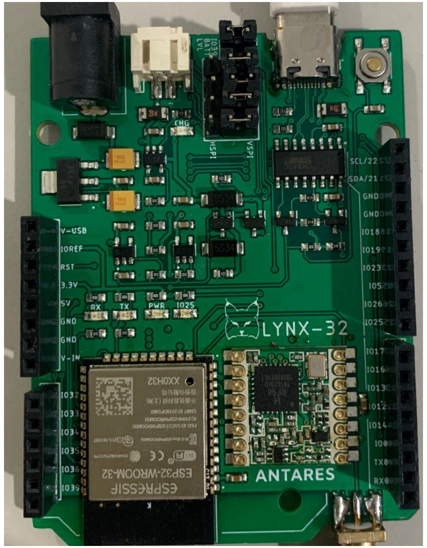
[redacted]00000000000000

Application Session Key

0000000000000000[redacted]

Are you sure you want to set this device as LoRa device?

Mengirimkan Data Dummy

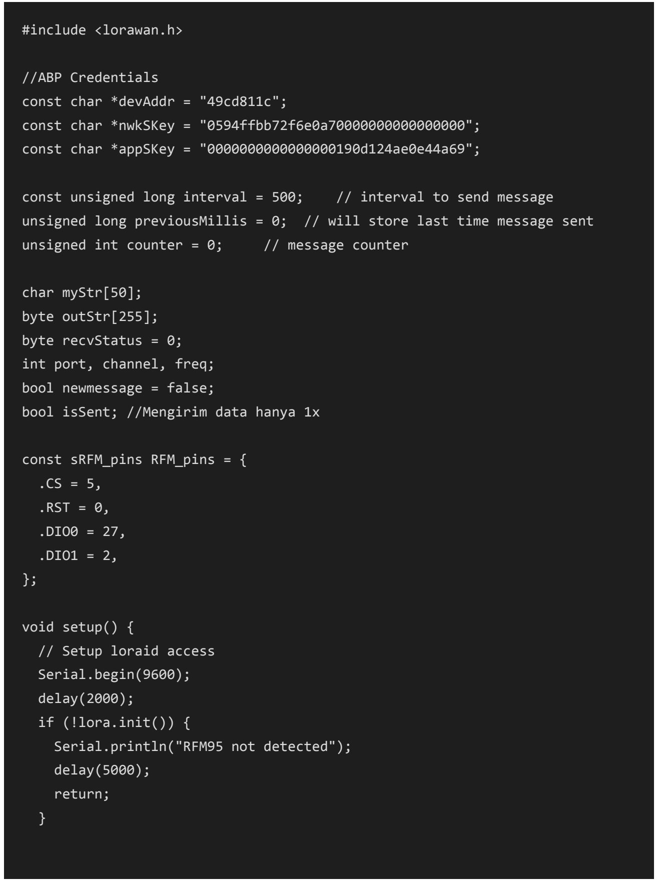


LoRaWAN →

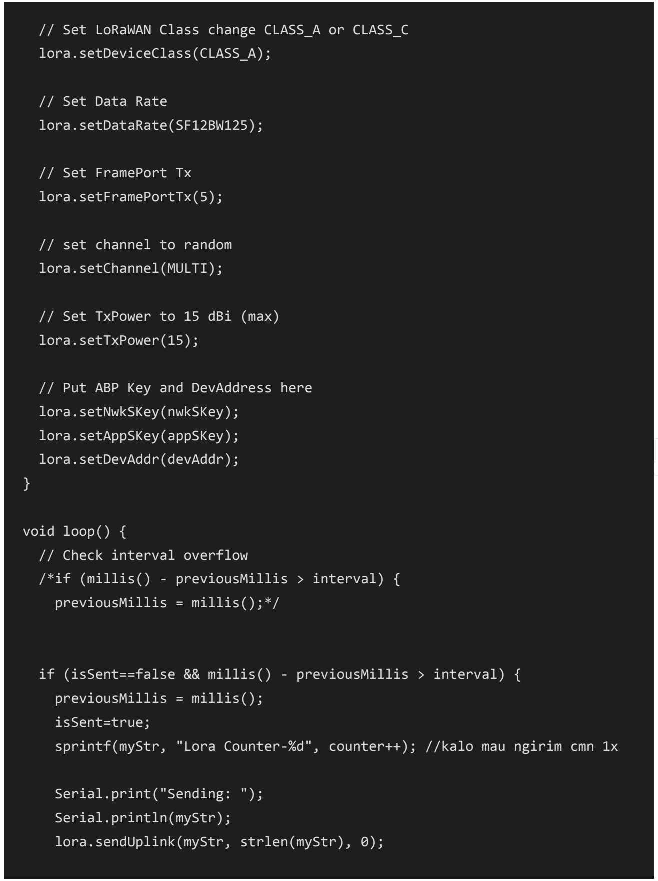
ANTARES

Mengirimkan Data Dummy

1



```
#include <lorawan.h>

//ABP Credentials
const char *devAddr = "49cd811c";
const char *nwkSKey = "0594ffbb72f6e0a70000000000000000";
const char *appSKey = "0000000000000000190d124ae0e44a69";

const unsigned long interval = 500;    // interval to send message
unsigned long previousMillis = 0;  // will store last time message sent
unsigned int counter = 0;     // message counter

char myStr[50];
byte outStr[255];
byte recvStatus = 0;
int port, channel, freq;
bool newmessage = false;
bool isSent; //Mengirim data hanya 1x

const sRFM_pins RFM_pins = {
  .CS = 5,
  .RST = 0,
  .DIO0 = 27,
  .DIO1 = 2,
};

void setup() {
  // Setup loraid access
  Serial.begin(9600);
  delay(2000);
  if (!lora.init()) {
    Serial.println("RFM95 not detected");
    delay(5000);
    return;
  }
```

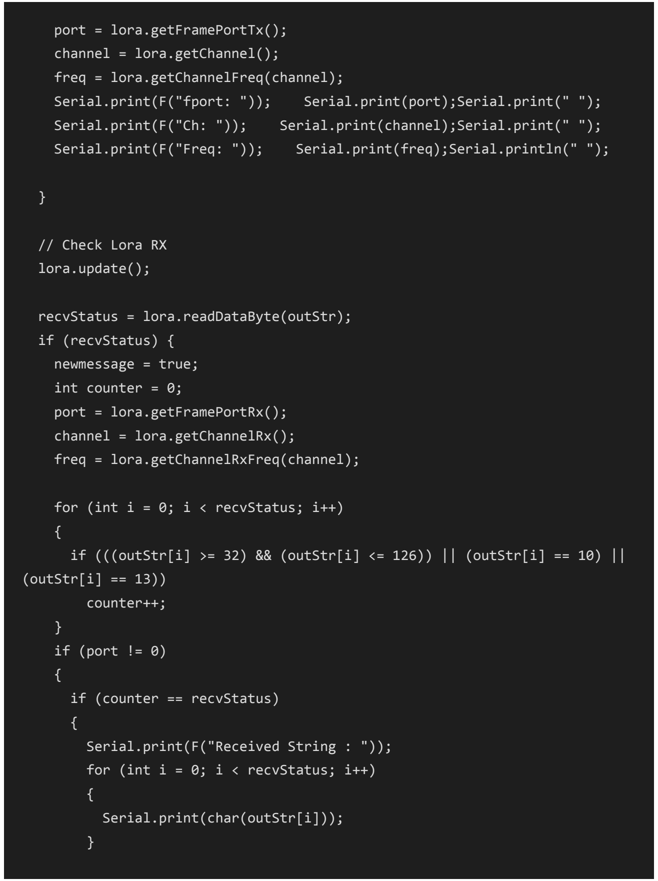


```
  // Set LoRaWAN Class change CLASS_A or CLASS_C
  lora.setDeviceClass(CLASS_A);

  // Set Data Rate
  lora.setDataRate(SF12BW125);

  // Set FramePort Tx
  lora.setFramePortTx(5);

  // set channel to random
  lora.setChannel(MULTI);

  // Set TxPower to 15 dBi (max)
  lora.setTxPower(15);

  // Put ABP Key and DevAddress here
  lora.setNwkSKey(nwkSKey);
  lora.setAppSKey(appSKey);
  lora.setDevAddr(devAddr);
}

void loop() {
  // Check interval overflow
  /*if (millis() - previousMillis > interval) {
    previousMillis = millis();*/


  if (isSent==false && millis() - previousMillis > interval) {
    previousMillis = millis();
    isSent=true;
    sprintf(myStr, "Lora Counter-%d", counter++); //kalo mau ngirim cmn 1x

    Serial.print("Sending: ");
    Serial.println(myStr);
    lora.sendUplink(myStr, strlen(myStr), 0);
```

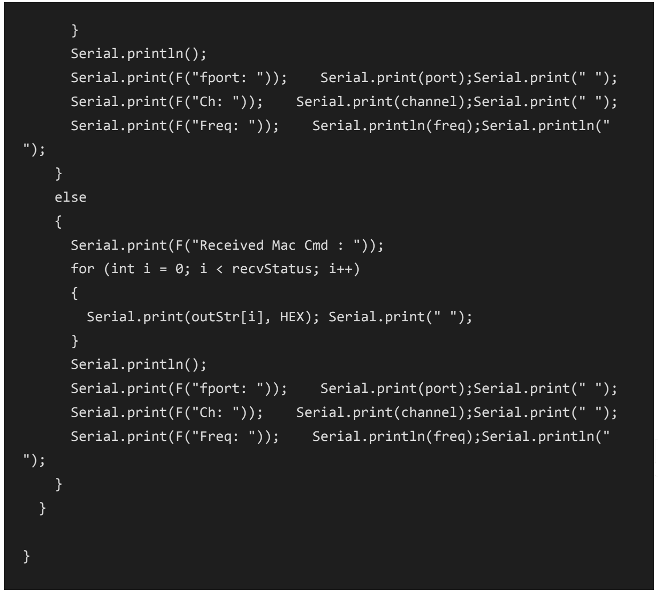
2

Mengirimkan Data Dummy

3



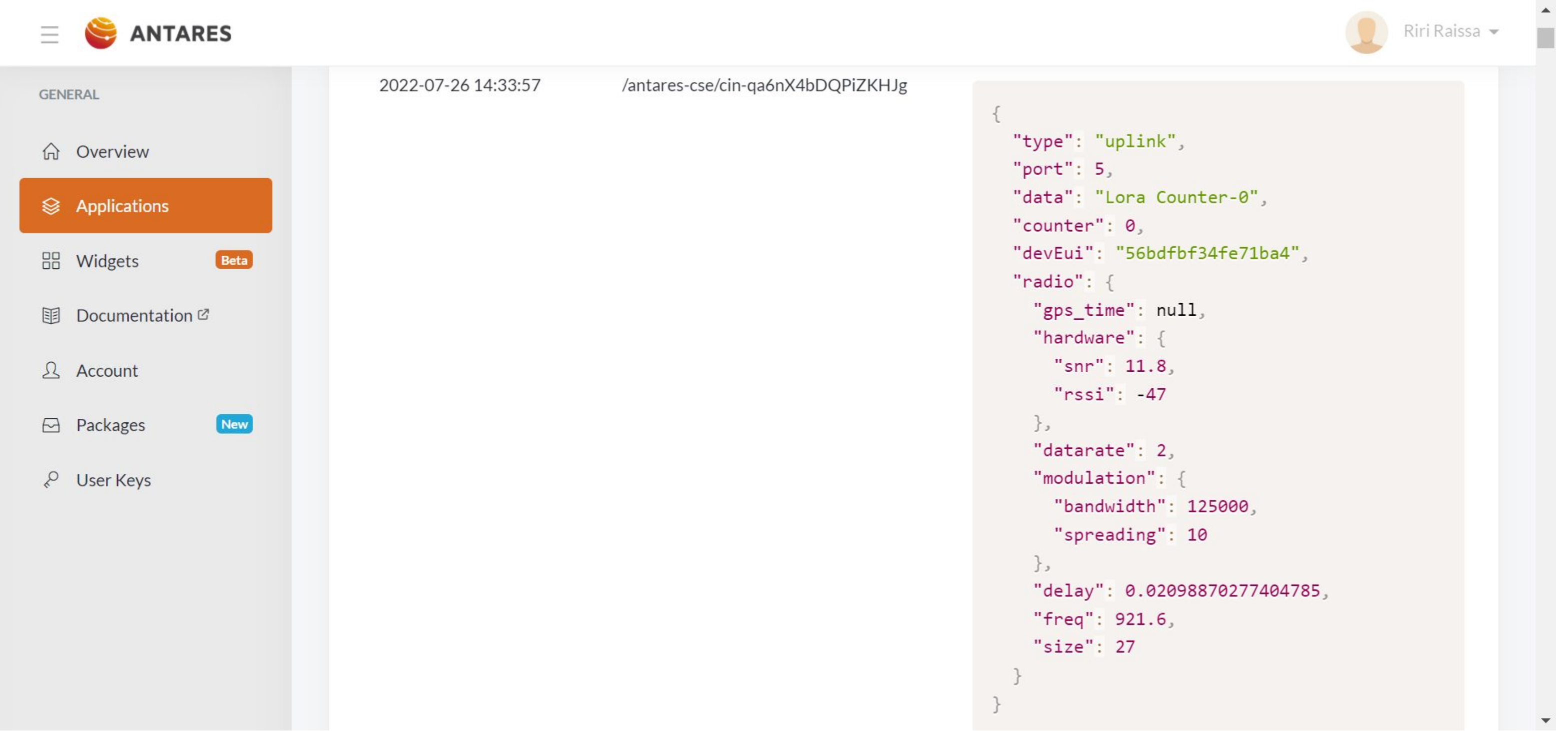
```
    port = lora.getFramePortTx();
    channel = lora.getChannel();
    freq = lora.getChannelFreq(channel);
    Serial.print(F("fport: "));    Serial.print(port);Serial.print(" ");
    Serial.print(F("Ch: "));    Serial.print(channel);Serial.print(" ");
    Serial.print(F("Freq: "));    Serial.print(freq);Serial.println(" ");

  }

  // Check Lora RX
  lora.update();

  recvStatus = lora.readDataByte(outStr);
  if (recvStatus) {
    newmessage = true;
    int counter = 0;
    port = lora.getFramePortRx();
    channel = lora.getChannelRx();
    freq = lora.getChannelRxFreq(channel);

    for (int i = 0; i < recvStatus; i++)
    {
      if (((outStr[i] >= 32) && (outStr[i] <= 126)) || (outStr[i] == 10) ||
(outStr[i] == 13))
        counter++;
    }
    if (port != 0)
    {
      if (counter == recvStatus)
      {
        Serial.print(F("Received String : "));
        for (int i = 0; i < recvStatus; i++)
        {
          Serial.print(char(outStr[i]));
        }
```



```
      }
      Serial.println();
      Serial.print(F("fport: "));    Serial.print(port);Serial.print(" ");
      Serial.print(F("Ch: "));    Serial.print(channel);Serial.print(" ");
      Serial.print(F("Freq: "));    Serial.println(freq);Serial.println("
");
    }
    else
    {
      Serial.print(F("Received Mac Cmd : "));
      for (int i = 0; i < recvStatus; i++)
      {
        Serial.print(outStr[i], HEX); Serial.print(" ");
      }
      Serial.println();
      Serial.print(F("fport: "));    Serial.print(port);Serial.print(" ");
      Serial.print(F("Ch: "));    Serial.print(channel);Serial.print(" ");
      Serial.print(F("Freq: "));    Serial.println(freq);Serial.println("
");
    }
  }

}
```

4

Output Mengirimkan Data Dummy



2022-07-26 14:33:57   /antares-cse/cin-qa6nX4bDQPiZKHJg

```
{
  "type": "uplink",
  "port": 5,
  "data": "Lora Counter-0",
  "counter": 0,
  "devEui": "56bdfbf34fe71ba4",
  "radio": {
    "gps_time": null,
    "hardware": {
      "snr": 11.8,
      "rssi": -47
    },
    "datarate": 2,
    "modulation": {
      "bandwidth": 125000,
      "spreading": 10
    },
    "delay": 0.02098870277404785,
    "freq": 921.6,
    "size": 27
  }
}
```

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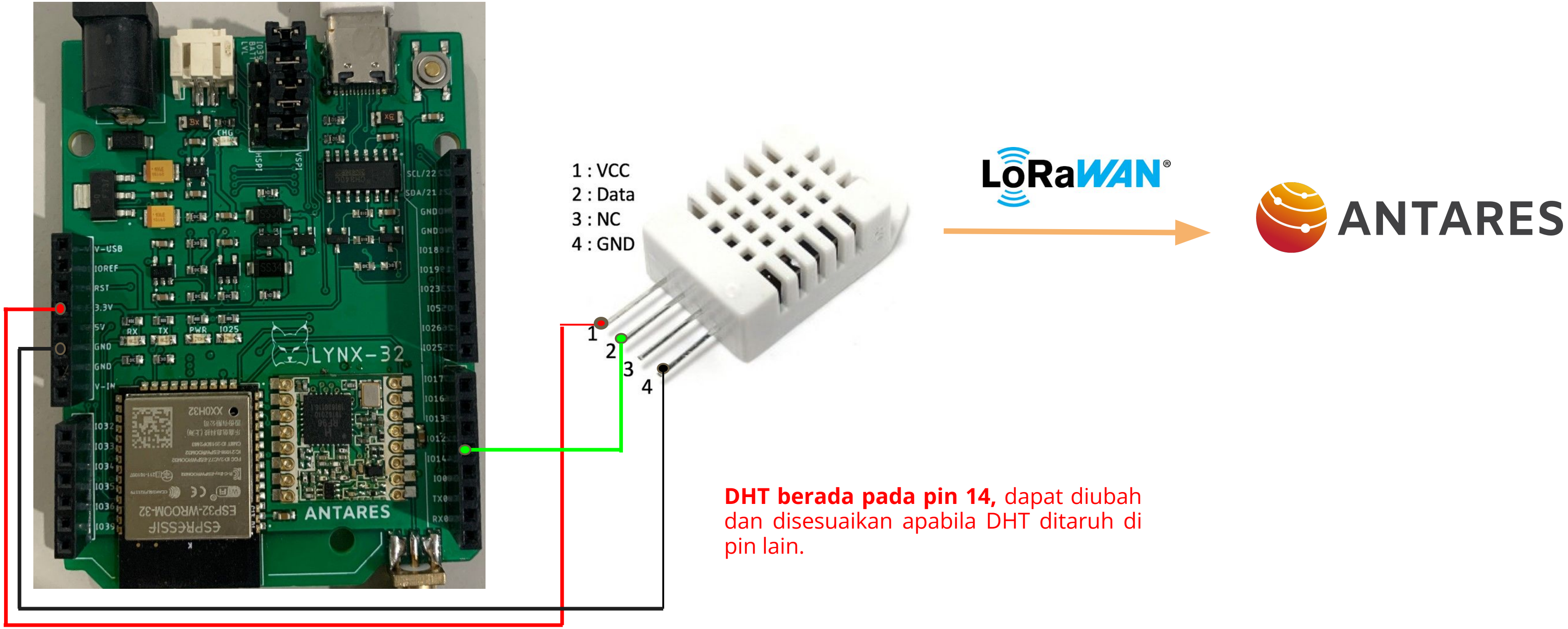
Mengirimkan Data Sensor Environment

Mengirimkan Data Sensor Environment

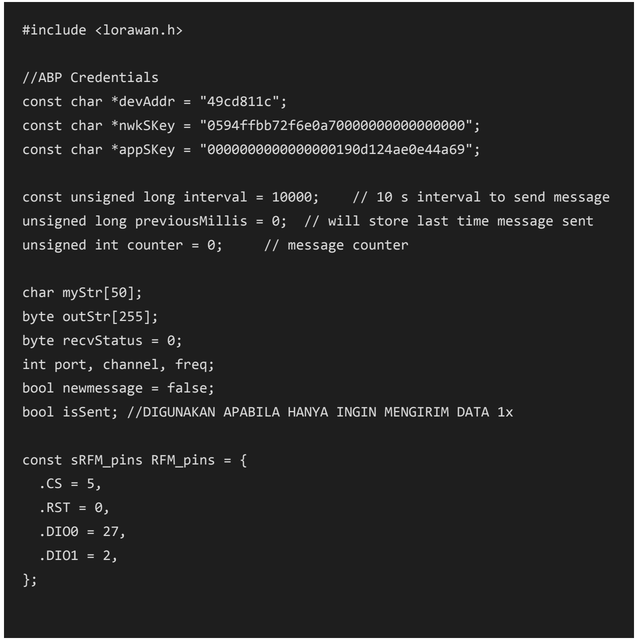


1 : VCC
2 : Data
3 : NC
4 : GND

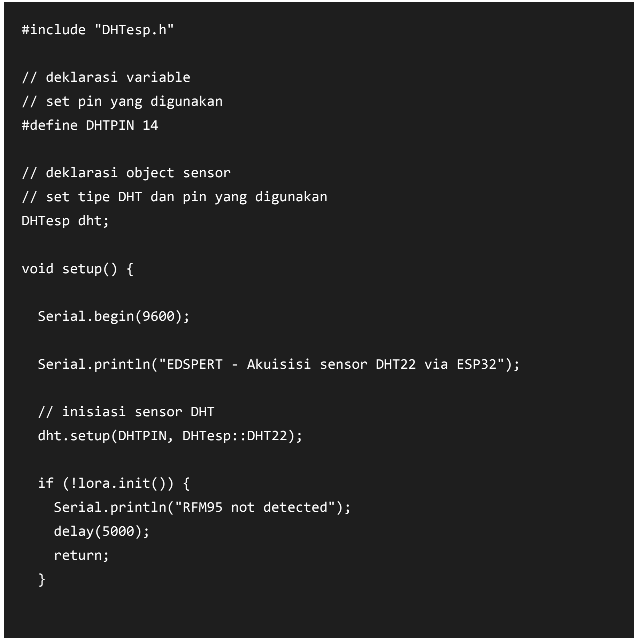
DHT berada pada pin 14, dapat diubah dan disesuaikan apabila DHT ditaruh di pin lain.

Mengirimkan Data DHT22

1



```
#include <lorawan.h>

//ABP Credentials
const char *devAddr = "49cd811c";
const char *nwkSKey = "0594ffbb72f6e0a70000000000000000";
const char *appSKey = "0000000000000000190d124ae0e44a69";

const unsigned long interval = 10000;    // 10 s interval to send message
unsigned long previousMillis = 0;  // will store last time message sent
unsigned int counter = 0;     // message counter

char myStr[50];
byte outStr[255];
byte recvStatus = 0;
int port, channel, freq;
bool newmessage = false;
bool isSent; //DIGUNAKAN APABILA HANYA INGIN MENGIRIM DATA 1x

const sRFM_pins RFM_pins = {
  .CS = 5,
  .RST = 0,
  .DIO0 = 27,
  .DIO1 = 2,
};
```



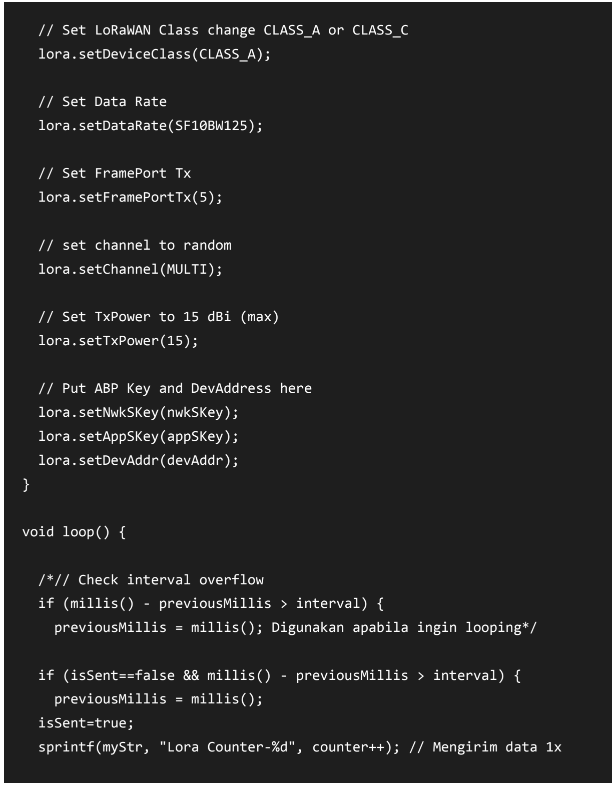
```
#include "DHTesp.h"

// deklarasi variable
// set pin yang digunakan
#define DHTPIN 14

// deklarasi object sensor
// set tipe DHT dan pin yang digunakan
DHTesp dht;

void setup() {

  Serial.begin(9600);

  Serial.println("EDSPERT - Akuisisi sensor DHT22 via ESP32");

  // inisiasi sensor DHT
  dht.setup(DHTPIN, DHTesp::DHT22);

  if (!lora.init()) {
    Serial.println("RFM95 not detected");
    delay(5000);
    return;
  }
```

2

Mengirimkan Data DHT22

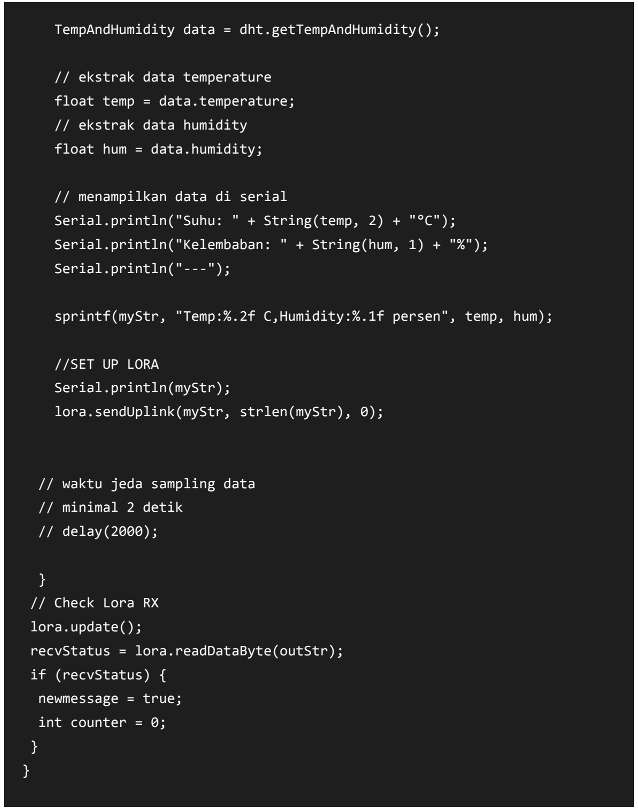
ANTARES

3



```
  // Set LoRaWAN Class change CLASS_A or CLASS_C
  lora.setDeviceClass(CLASS_A);

  // Set Data Rate
  lora.setDataRate(SF10BW125);

  // Set FramePort Tx
  lora.setFramePortTx(5);

  // set channel to random
  lora.setChannel(MULTI);

  // Set TxPower to 15 dBi (max)
  lora.setTxPower(15);

  // Put ABP Key and DevAddress here
  lora.setNwkSKey(nwkSKey);
  lora.setAppSKey(appSKey);
  lora.setDevAddr(devAddr);
}

void loop() {

  /*// Check interval overflow
  if (millis() - previousMillis > interval) {
    previousMillis = millis(); Digunakan apabila ingin looping*/

  if (isSent==false && millis() - previousMillis > interval) {
    previousMillis = millis();
  isSent=true;
  sprintf(myStr, "Lora Counter-%d", counter++); // Mengirim data 1x
```

4



```
    TempAndHumidity data = dht.getTempAndHumidity();

    // ekstrak data temperature
    float temp = data.temperature;
    // ekstrak data humidity
    float hum = data.humidity;

    // menampilkan data di serial
    Serial.println("Suhu: " + String(temp, 2) + "°C");
    Serial.println("Kelembaban: " + String(hum, 1) + "%");
    Serial.println("---");

    sprintf(myStr, "Temp:%.2f C,Humidity:%.1f persen", temp, hum);

    //SET UP LORA
    Serial.println(myStr);
    lora.sendUplink(myStr, strlen(myStr), 0);


  // waktu jeda sampling data
  // minimal 2 detik
  // delay(2000);

  }
 // Check Lora RX
 lora.update();
 recvStatus = lora.readDataByte(outStr);
 if (recvStatus) {
  newmessage = true;
  int counter = 0;
 }
}
```

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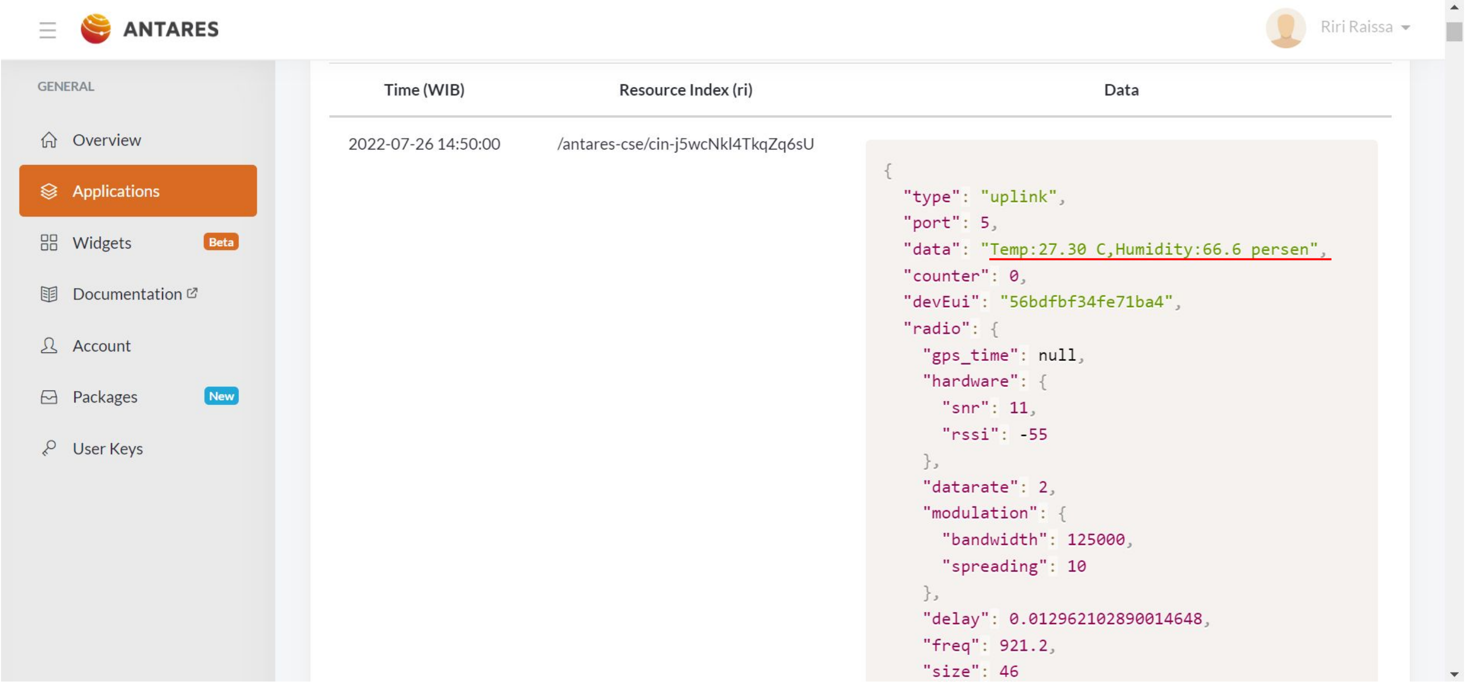
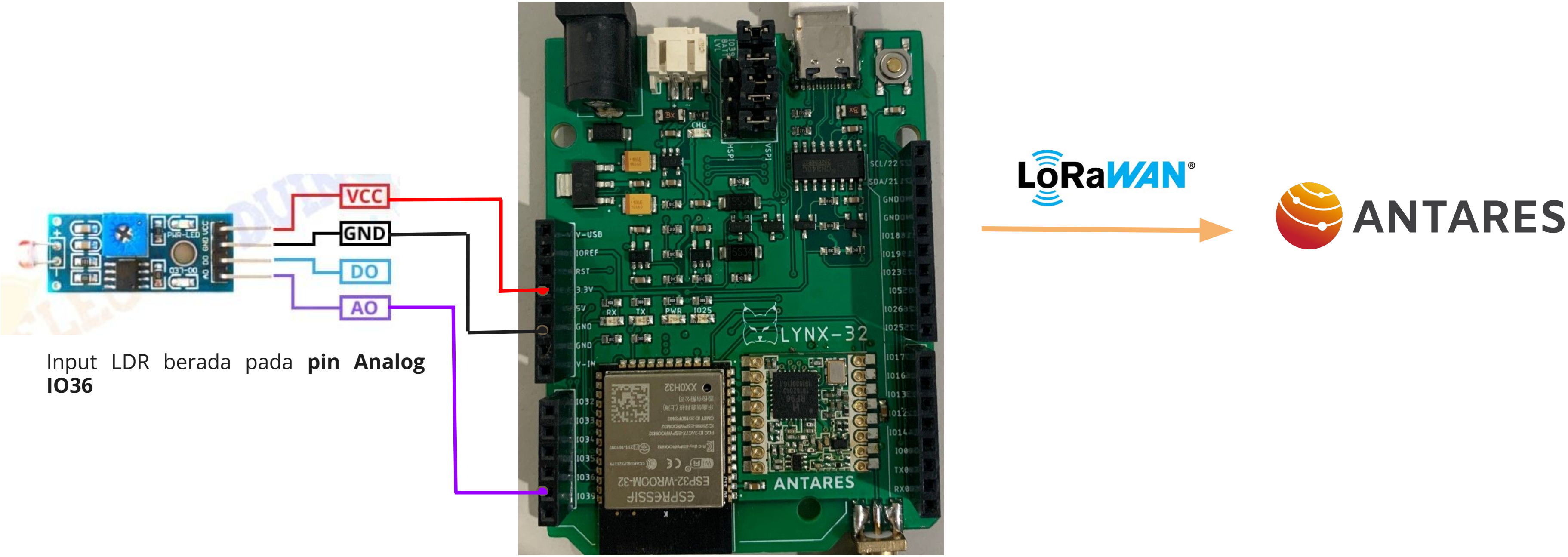
Output Mengirimkan Data Sensor Environment



Time (WIB)	Resource Index (ri)	Data
2022-07-26 14:50:00	/antares-cse/cin-j5wcNkl4TkqZq6sU	see below

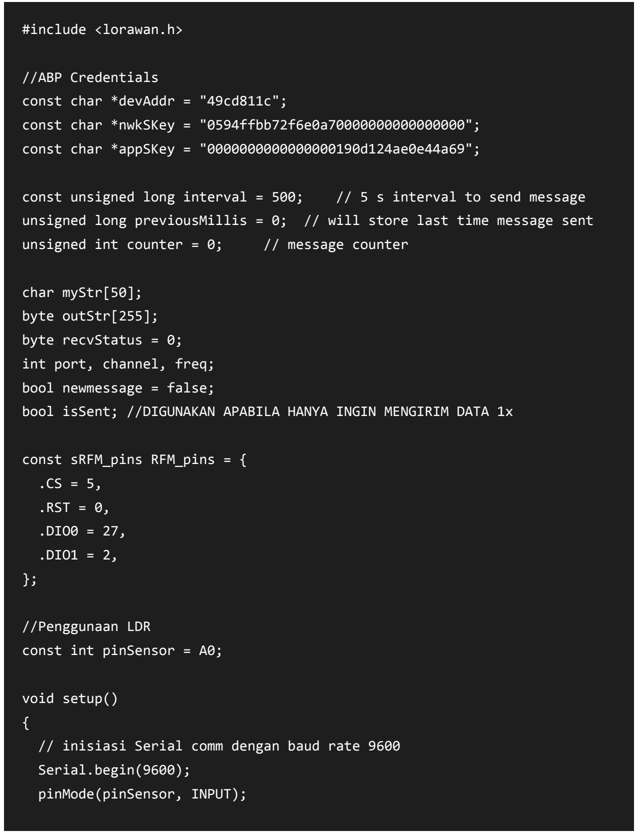
```
{
  "type": "uplink",
  "port": 5,
  "data": "Temp:27.30 C,Humidity:66.6 persen",
  "counter": 0,
  "devEui": "56bdfbf34fe71ba4",
  "radio": {
    "gps_time": null,
    "hardware": {
      "snr": 11,
      "rssi": -55
    },
    "datarate": 2,
    "modulation": {
      "bandwidth": 125000,
      "spreading": 10
    },
    "delay": 0.012962102890014648,
    "freq": 921.2,
    "size": 46
```

Mengirimkan Data Sensor LDR



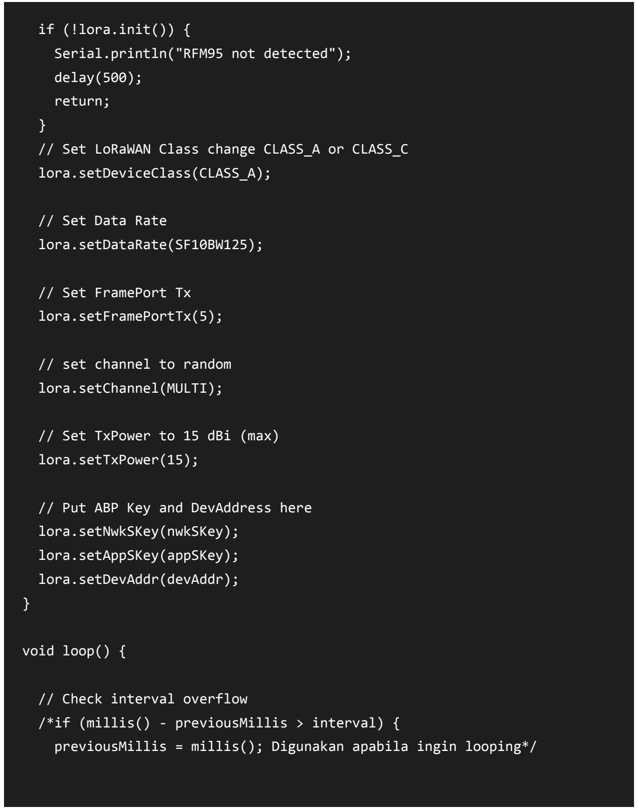
Input LDR berada pada **pin Analog IO36**

Mengirimkan Data Sensor LDR



```
#include <lorawan.h>

//ABP Credentials
const char *devAddr = "49cd811c";
const char *nwkSKey = "0594ffbb72f6e0a70000000000000000";
const char *appSKey = "0000000000000000190d124ae0e44a69";

const unsigned long interval = 500;    // 5 s interval to send message
unsigned long previousMillis = 0;  // will store last time message sent
unsigned int counter = 0;     // message counter

char myStr[50];
byte outStr[255];
byte recvStatus = 0;
int port, channel, freq;
bool newmessage = false;
bool isSent; //DIGUNAKAN APABILA HANYA INGIN MENGIRIM DATA 1x

const sRFM_pins RFM_pins = {
  .CS = 5,
  .RST = 0,
  .DIO0 = 27,
  .DIO1 = 2,
};

//Penggunaan LDR
const int pinSensor = A0;

void setup()
{
  // inisiasi Serial comm dengan baud rate 9600
  Serial.begin(9600);
  pinMode(pinSensor, INPUT);
```

1

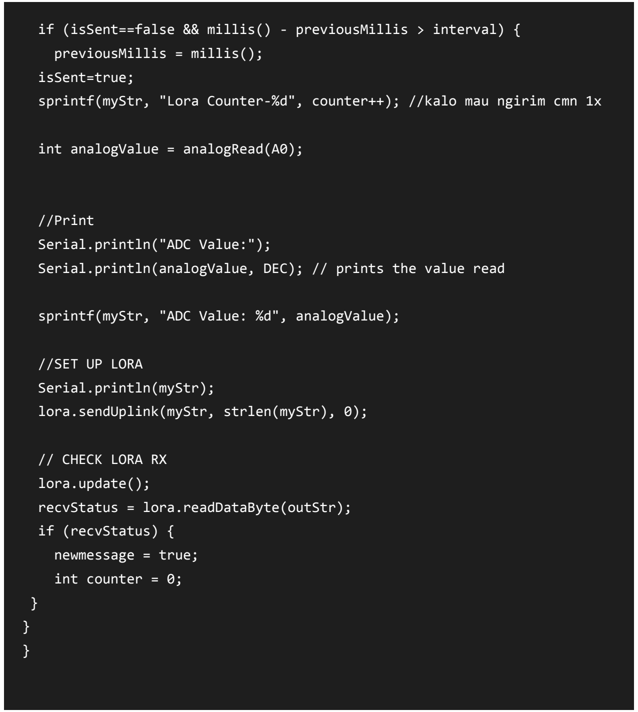


```
    if (!lora.init()) {
      Serial.println("RFM95 not detected");
      delay(500);
      return;
    }
    // Set LoRaWAN Class change CLASS_A or CLASS_C
    lora.setDeviceClass(CLASS_A);

    // Set Data Rate
    lora.setDataRate(SF10BW125);

    // Set FramePort Tx
    lora.setFramePortTx(5);

    // set channel to random
    lora.setChannel(MULTI);

    // Set TxPower to 15 dBi (max)
    lora.setTxPower(15);

    // Put ABP Key and DevAddress here
    lora.setNwkSKey(nwkSKey);
    lora.setAppSKey(appSKey);
    lora.setDevAddr(devAddr);
  }

  void loop() {

    // Check interval overflow
    /*if (millis() - previousMillis > interval) {
      previousMillis = millis(); Digunakan apabila ingin looping*/
```

2

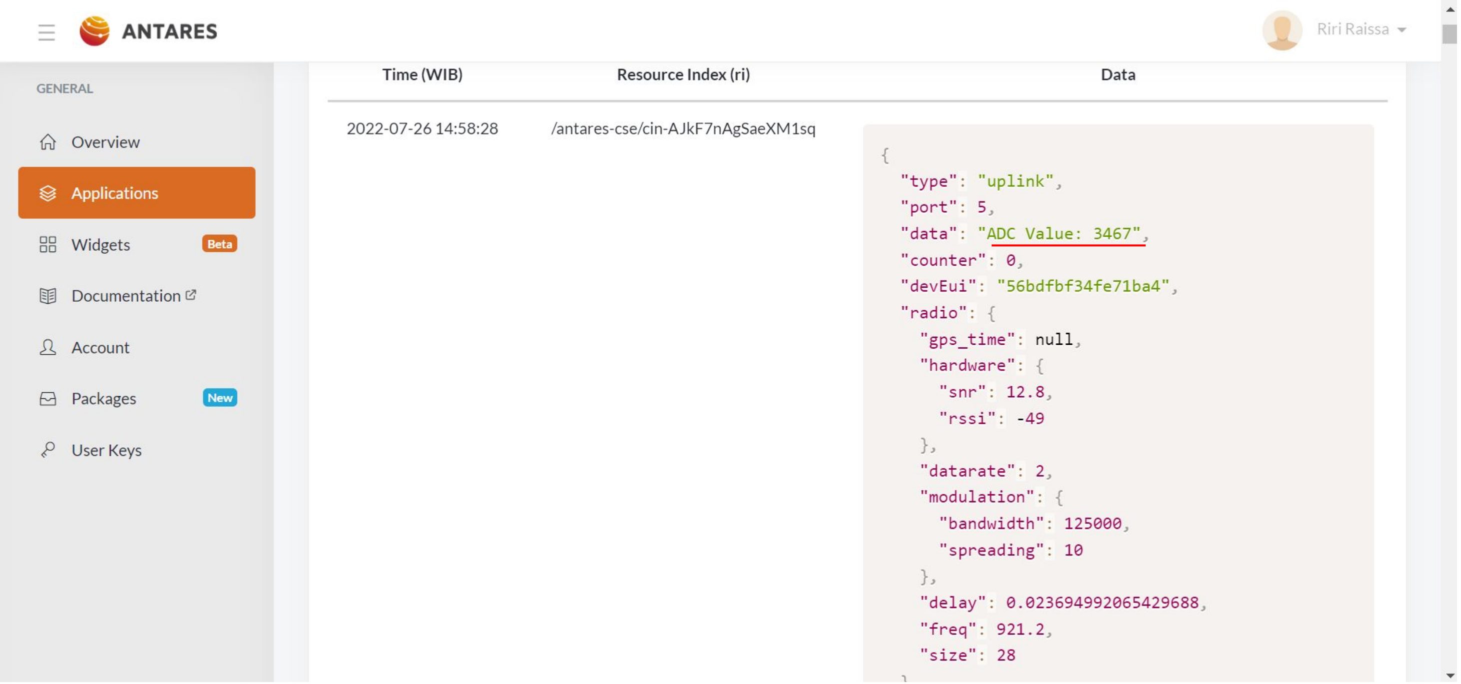
Mengirimkan Data Sensor LDR

3



```
  if (isSent==false && millis() - previousMillis > interval) {
    previousMillis = millis();
  isSent=true;
  sprintf(myStr, "Lora Counter-%d", counter++); //kalo mau ngirim cmn 1x

  int analogValue = analogRead(A0);


  //Print
  Serial.println("ADC Value:");
  Serial.println(analogValue, DEC); // prints the value read

  sprintf(myStr, "ADC Value: %d", analogValue);

  //SET UP LORA
  Serial.println(myStr);
  lora.sendUplink(myStr, strlen(myStr), 0);

  // CHECK LORA RX
  lora.update();
  recvStatus = lora.readDataByte(outStr);
  if (recvStatus) {
    newmessage = true;
    int counter = 0;
 }
}
}
```

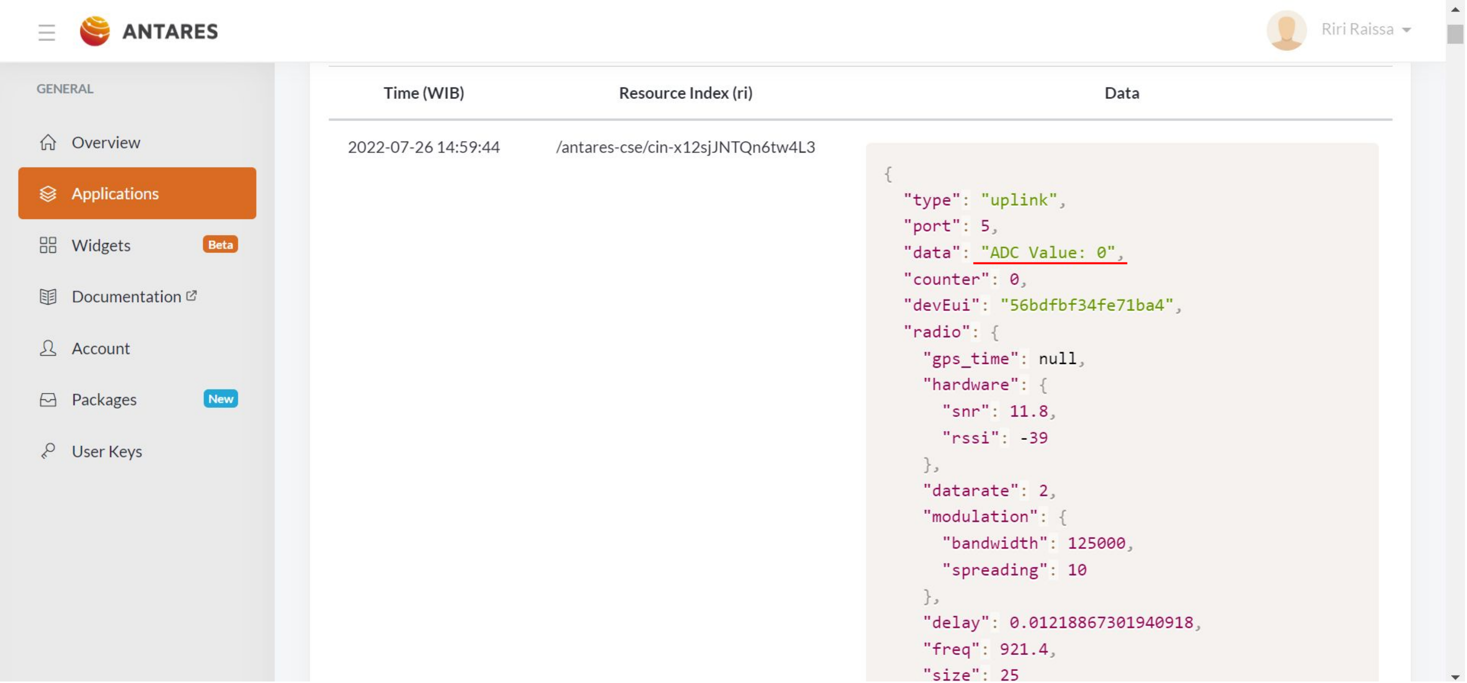
Output Mengirimkan Data Sensor LDR Gelap



Time (WIB)	Resource Index (ri)	Data
2022-07-26 14:58:28	/antares-cse/cin-AJkF7nAgSaeXM1sq	

```
{
  "type": "uplink",
  "port": 5,
  "data": "ADC Value: 3467",
  "counter": 0,
  "devEui": "56bdfbf34fe71ba4",
  "radio": {
    "gps_time": null,
    "hardware": {
      "snr": 12.8,
      "rssi": -49
    },
    "datarate": 2,
    "modulation": {
      "bandwidth": 125000,
      "spreading": 10
    },
    "delay": 0.023694992065429688,
    "freq": 921.2,
    "size": 28
```

Output Mengirimkan Data Sensor LDR Terang



Time (WIB)	Resource Index (ri)	Data
2022-07-26 14:59:44	/antares-cse/cin-x12sjJNTQn6tw4L3	see below

```
{
  "type": "uplink",
  "port": 5,
  "data": "ADC Value: 0",
  "counter": 0,
  "devEui": "56bdfbf34fe71ba4",
  "radio": {
    "gps_time": null,
    "hardware": {
      "snr": 11.8,
      "rssi": -39
    },
    "datarate": 2,
    "modulation": {
      "bandwidth": 125000,
      "spreading": 10
    },
    "delay": 0.01218867301940918,
    "freq": 921.4,
    "size": 25
```

TUGAS

Kirimkan data sensor DHT22 dan LDR secara bersamaan ke 1 device ANTARES

HINT
Gabungkan kode sesi 2 dan sesi 3