Long Range Communication for Medical Devices

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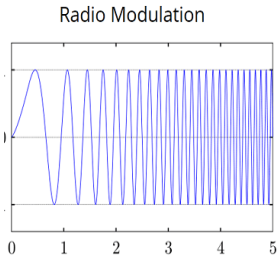
Abstract **- Late market studies show that the market for far off checking gadgets of various clinical boundaries will develop dramatically. Worldwide, multiple million people will be checked distantly according to the point of view of various wellbeing boundaries by 2023. Of specific significance is the method of distant transmission of the data gained from the clinical sensors. As of now, there are a few strategies like Bluetooth, WI-FI, or other remote correspondence interfaces. As of late, the correspondence dependent on LoRa (Long Range) innovation has had a dangerous improvement that permits the transmission of data over significant distances with low energy utilization. The execution of the IoT (Internet of Things) applications utilizing LoRa gadgets dependent on open Long-Range Wide-Area Network (Lora WAN) convention for significant distances with low energy utilization can likewise be utilized in the clinical field. Along these lines, in this paper, we proposed and fostered a significant distance correspondence engineering for clinical gadgets dependent on the LoRaWAN convention that permits information interchanges over a distance of in excess of 10 km.**

Index Terms **- Long-Range Wide-Area Network (Lora WAN), the IoT (Internet of Things), Clinical boundaries.**

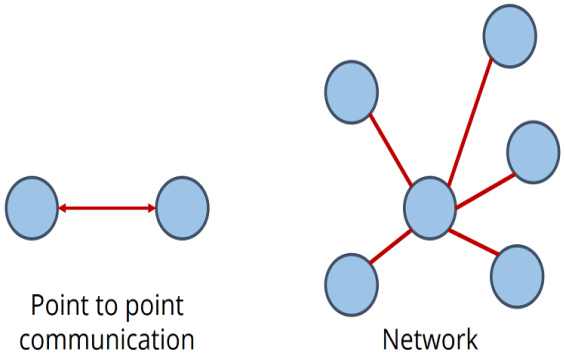
INTRODUCTION

LoRa is a short form for Long Range. It is a wireless Radio frequency technology developed by the company Semtech. This LoRa technology can be used to send bi-directional information over long distances while consuming little power. This property can be used by remote sensors that should transmit data while only using a small battery. Lora typically has a range of 15-20km (more on this later) and can run for years on a single charge. Realize that LoRa, Lora WAN, and LPWAN are all unique terminologies.



LoRa employs unlicensed frequencies that are widely available around the world. The following are the most commonly used frequencies:
Europe's frequency is 868 MHz, 915 MHz is the North American frequency, Asia's 433 MHz band.

LoRa Topologies:



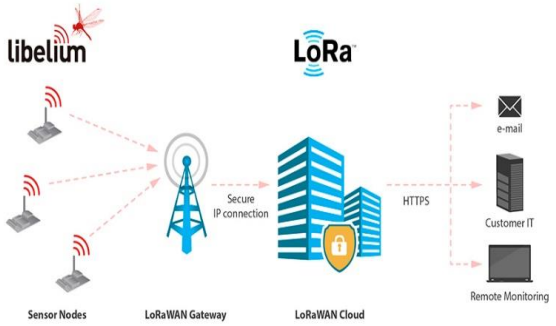
- Communication from one point to another
- Create a LoRa network instead (using Lora WAN for example)

Communication from one point to another:
Two LoRa-enabled devices communicate with each other via RF signals in point-to-point communication. This is basic for transferring data between two ESP32 boards equipped with LoRa transceiver chips that are relatively far apart or in environments at which Wi-Fi coverage is absent.

Lora WAN:

The Lora WAN protocol is a Low Power Wide Area Network (LPWAN) specification derived from the LoRa Alliance's normalized LoRa technology.

A LoRa Node is typically powered by a battery and is comprised of a Radio Module and a Microprocessor. The microprocessor reads data from the sensor and sends it into the air via the radio module, where it is picked up by a LoRa Gateway. The LoRa Gateway also has a Radio Module and a Microprocessor, but they are typically powered by AC mains because they require more power.



LoRa is classified as an LPWAN, which stands for Low Power Wide Area Network. Not only can LoRa operate on LPWAN, but other technologies including such Narrow Band IoT (NB-IOT), Sigfox, and others are also capable of doing so. When LoRa technology was introduced, it needs a specific set of protocols to be followed by all manufacturers, so the LoRa alliance was formed, which then introduced the Lora WAN. Lora WAN is a modified form of LPWAN that specifies the protocol for using LoRa in a physical layer to send and receive data between nodes, gateways, and the internet.

Many people compare LoRa to Wi-Fi or Bluetooth, but neither compares to Lora. Bluetooth is used to send data between two Bluetooth devices, whereas Wi-Fi is used to send data between an Access Point (Router) and a Station (Mobile).However, LoRa technology was not designed to transmit data between two LoRa modules.

EXPERMENATAL ANALASIS

Transmitter LoRa

Lora SX1278 and esp8266 communication with DHT sensor.

Transmitting module consist of LoRa that provide spread spectrum communication and high interference that minimize the current consumption Using a low-cost crystal, SX1278 can achieve a sensitivity of more than -148dBm.The combination of high sensitivity and an integrated +20dBm power amplifier results in an industry-leading link budget, making it ideal for any application requiring range or robustness.

Lora SX1278 also outperforms conventional modulation techniques in terms of blocking and selectivity, resolving the traditional design. The DHT11 is a basic digital temperature and humidity sensor that is extremely inexpensive. It measures the surrounding air with a capacitive humidity sensor and a thermistor and outputs a digital signal on the data pin. This is a blue OLED display module with a 0.96-inch diagonal. Using SPI/IIC protocols, the display module can communicate with any microcontroller. It has a resolution of 128x64 pixels. The package contains a display board, a display, and a 4 pin male header that has been pre-soldered to the board.

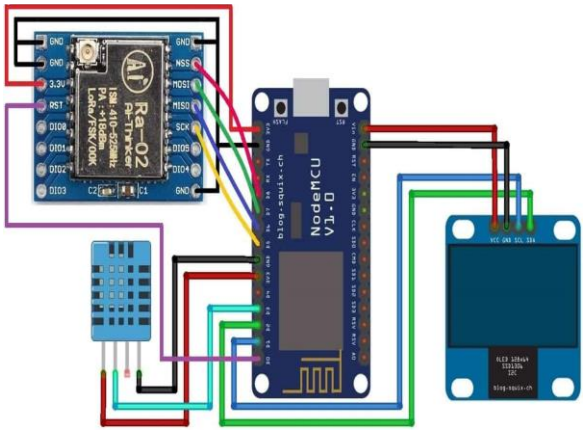


Fig 2 LoRa Transmitter

Recevier lora

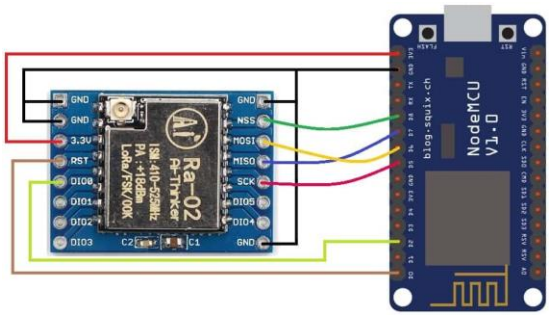


Fig 3 LoRa Receiver

The SX1278 transceiver module will be used to send and receive LoRa messages with the ESP32.All LoRa modules are transceivers, meaning they can send and receive data. You will require two of them.

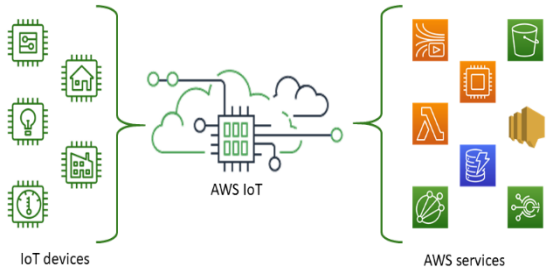
AWSIoT Core

Nowadays, the Internet of Things (IoT) is integrated into almost every device. There are countless hardware and software IoT platforms on the market for establishing IoT-based applications. In my previous article, I described how to connect a DHT22 to a NodeMCU and send the temperature and humidity to a Thing speak webserver. Similarly, we can connect sensors to hardware development kits such as ESP32, ESP8266, Raspberry Pi, Particleboards (Aargon, Boron, Xenon), and send data to clouds such as Thing speak, Ubidots, AWS IoT Core, and Microsoft Azure. Amazon is not only development of e, but it is also focusing on IoT and providing a cloud-based platform called AWS IoT. AWS IOT is an abbreviation for Amazon Web Service Internet of Things. This service enables us to securely connect our devices to the internet for processing, operating, and exchanging data. Aside from AWS IoT, Amazon Web Services offers a plethora of other services such as virtual machine deployment, web hosting, and so on.

AWS IoT Core supports connections with IoT devices, wireless gateways, services, and apps. Devices connect to the AWS IoT Core so they can send data to and receive data from AWS IoT services and other devices. Apps and other services also connect to AWS IoT Core to control and manage the IoT devices and process the data from your IoT solution. This section describes how to choose the best way to connect and communicate with AWS IoT Core for each aspect of your IoT solution. Figure4.

Fig 4 AWS IoT

There are cloud services provided by Amazon Web Services for IoT that connect your IoT devices and AWS cloud services. If you're interested in integrating your IoT devices into AWS IoT-based solutions, check out AWS IoT's device software. Using AWS IoT, your devices can be connected to the cloud services that AWS offers.



When publishing and subscribing to messages, the AWS IoT Core message broker supports devices and clients that use MQTT or MQTT over WSS protocols. Support for HTTPS-enabled devices and clients is included.

Multiple communication scenarios are supported by IoT applications, including those between devices, between devices and the cloud and between devices and users. A majority of MQTT communication models stem from three MQTT patterns: point-to-point, broadcast, and fan-in.

IoT Rules

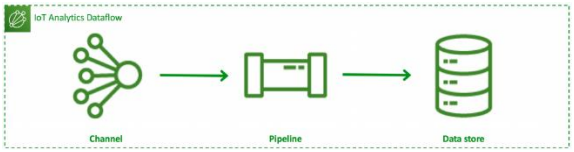
When AWS IoT gets messages from your devices, it follows IoT regulations, according to AWS.A rule extracts data from messages, evaluates expressions based on message data, and executes one or more actions when the rule's conditions are fulfilled.

IoT Rule Actions

When the rule's query returns results, the Lambda function processes those results and passes them on to an AWS IoT rule action. What happens when an AWS IoT rule triggers an action? Sends a message via AWS IoT Analytics channel as the result of this rule's operation.

AWS IoT Analytics

"IoT Analytics" is a fully-managed solution, according to Amazon Web Services, that makes it easy to execute and operationalize advanced analytics on huge quantities of IoT data. Five components make up IoT Analytics - channels (or channels and pipelines), data stores (or data stores), datasets, and notebooks.



Messages are sent to the IoT Analytics channel via the IoT Rule's IoT rule. The channel publishes the data to a pipeline for processing. In the pipeline, you consume messages from the channel and process and filter them before saving them in the data store, allowing you to process and filter them. Receives and stores message data in a data storage unit (DSU).For retrieval, you need to create a SQL dataset or an object-oriented dataset (ODBC).When a query against the data store is run against the SQL dataset, a SQL query is returned. Documentation states that Amazon Athena and Amazon IoT Analytics SQL expressions are based on Presto DB.

EQUIPMENTS

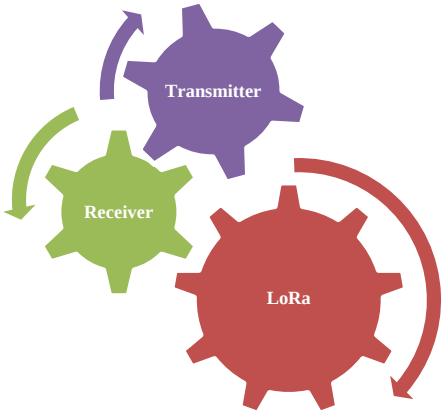
A. Hardware

- ESP8266 (SX1278)
- LoRa AI tinker ra-02 433Mhz

B. Software

- Arduino ide
- OpenSSL
- AWS IoT Core

PROPOSED METHODOLOGY



BLOCK DIGARAM

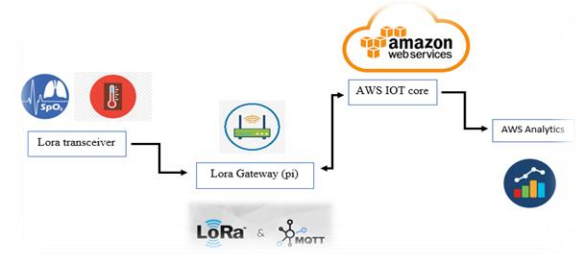
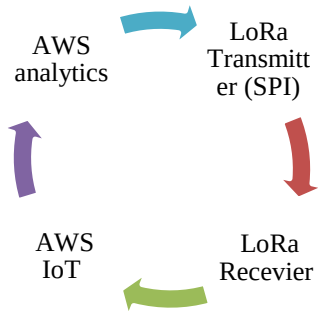


Fig5: Block diagram

Working

Considering a physiological parameter of body example temperature and humidity (DHT12 sensor).LoRa is long radio transceiver with serial peripheral interface with esp8266 as client and another LoRa transceiver as server with AWS-IoT core. With help of MQTT protocol Lora receiver publish the data to AWS IoT by subscribing the topic. Temperature sensor data will publish to AWS IoT Core. The data securely transmitted to cloud by RSA (keys) and certificate policy. Edge device is connected to AWS IoT, Rules adjusted such that data is transmitted to device (exact device).actions are made to access the services of AWS IoT. Here we are using AWS IoT Analytics to extracting the data which are more important example DTH sensor gives values of humidity with temperature ,by writing SQL command to perform data operations to send specific data to AWS IoT. Here we wrote the SQL condition to send data if the humidity is above 90. This data subscribed to topic creating a topic to this data this results gives the values. Data is transferred pipeline by sending the data through channels. This data can be extracted by downloading the data in excel format. By storing data in AWS S3 and channeling the data into AWS Quick Sight. This service gives the visualization of data with real time plots and data. This can be again send to any kind of telemetry device.



AWS-IoT core with ESP8266

1. Creating a Thing in the AWS, generating a certificate and attaching a policy to it.
2. Converting AWS credential(Certificate, Private Key, Root CA) from .pem to .der format
3. Installing ESP8266 sketch data upload tool in Arduino IDE
4. Arduino sketch and modifications according to the thing.
5. Uploading AWS certificates & code to the NodeMCU ESP8266
6. Testing/Subscription of thing on Amazon Web Services (AWS).
7. Results& Data Analytics.

Creating AWS thing with Certificate and policy

- STEP1: In the wake of making account, look for "IoT center" under AWS administration, click on it to open the control center.

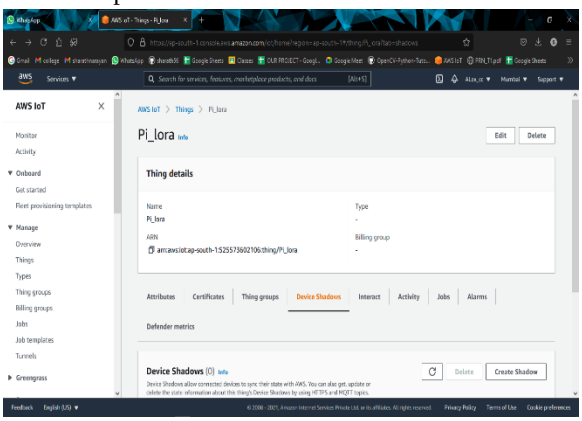


Fig6: IoT thing

- STEP2: Getting started with AWS IoT.
- STEP3: Register a Thing in our case it is LoRa with ESP826. It acts like an IoT device.
- STEP4: Create a Certificate.

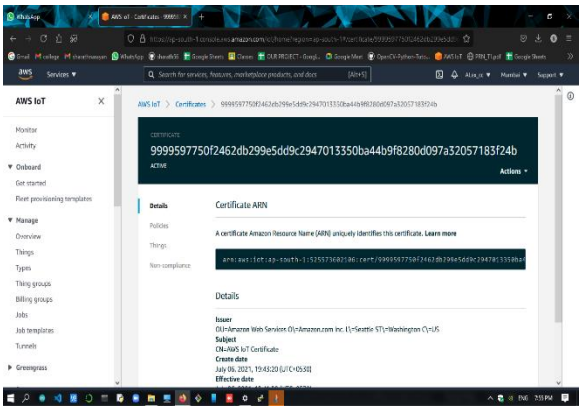


Fig6: Certificate and policy

- STEP5: The keys for the Thing which are created earlier are provided by AWS. These keys provide access to the Thing. Three key files are been downloaded by clicking on Activate button and saved in the PC.
- STEP6: By clicking on 'Attach a policy' policy for the Thing is created after the Certificate is created.
- STEP7: No policies are present at this time in the account as we created no account so far. Now we need to click on 'Register Thing'.
- STEP8: After the window gets open, we need to click on the 'secure' and 'policies' shown in the left side of the menu and by this we can create policy.

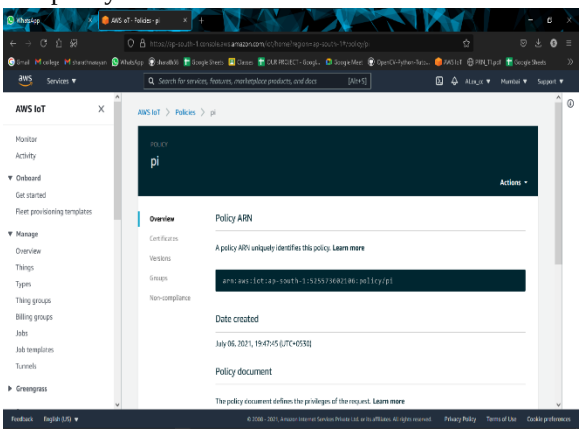


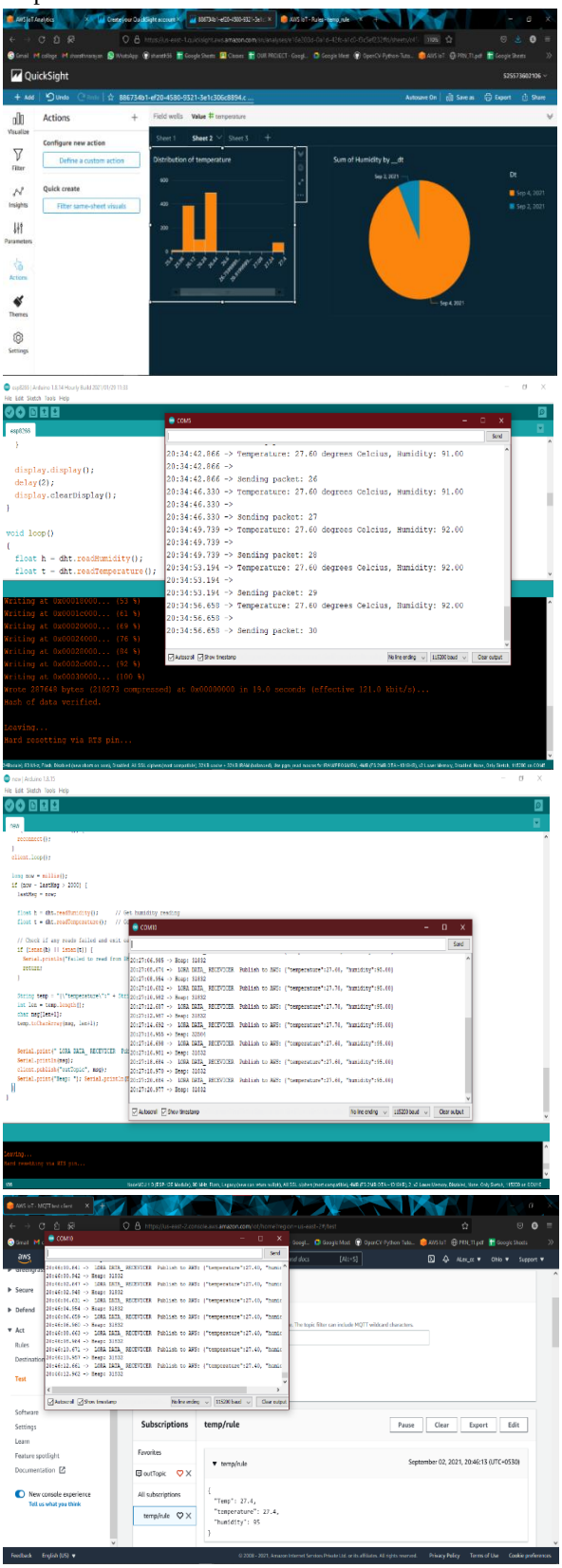
Fig7: policy attach

- STEP9: Now we need to click on 'Create a policy'.
- STEP10: Here we can name the policy accordingly. After checking the allow button we need to type 'IoT:*' in the 'action box' and type '*' in Resources ARN. Finally create policy by clicking on the 'create' button.
- STEP11: Click on 'secure' and then the 'certificates' after opening a window. Policy is created then it is attached by clicking on 'certificates' and 'attach policy'.
- STEP12: We have to select the created policy name and then click on 'attach' button.
- After getting a broker address of the Thing, the working of the Thing is checked by using the 'test' option present in the 'AWS IoT console'.

RESULTS

AWS IoT Quick Sight:

Data visualization of DTH11 sensor in Real-time with help of AWS S3.



CONCULSION

In this paper, we proposed a significant distance correspondence engineering for clinical gadgets dependent on Lora WAN Protocol, which is committed to long haul wellbeing checking of clients/patients in metropolitan/country conditions without help and is coordinated into a more extensive IoT foundation. For this significant distance correspondence design for clinical gadgets dependent on Lora WAN convention. These were performed over distances that didn't experience snags, (for example, geological snags or structures); no enhancements were made as far as inclusion and energy utilization, transmission distance, and the number of hubs the Lora WAN door can acknowledge. There is a requirement for additional double-dealing and reconciliation of clinically usable gadgets in such keen frameworks. Right assessment of clinical indications, for example, ECG waves, is

Essential. These new methodologies will have a direct clinical effect since they will be utilized for the finding, observing, and treatment of the patients, utilizing the freshest and most progressed obtaining and correspondence advancements utilizing LoRa.

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