International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.05, March 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

Single Channel Gateway Using Low Power Wide Area Network

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ABSTRACT

A Low Power Wide Area Network is a family of Wireless Networks which is used to provide Low Power, Long Range Communications using sensors and batteries which are used for monitoring and sensing devices such as Automated meter reading. Low Power Wide Area Network consists of various technologies such as Sigfox, LoRA, Ingenu, Weightless. LoRa is known as Long Range and it is a proprietary spread spectrum modulation. It mainly uses chirp spread spectrum modulation which consists of orthogonal spreading factor. They will provide Inherent Robustness and low power for Transmission. LoRa is a PHY layer Implementation which consists of fixed bandwidth to optimize network performance. LoRA uses LoRaWAN which is known as Long Range Wide Area Network for transmission. It consists of Gateway, Network Server and End devices. Gateways are used for sending and receiving messages between Transmitter and Receiver. A single channel Gateway is Implemented using LoRa Transceiver and Raspberry Pi which is of low cost with inherent Robustness

KeywordsEnd devices, Gateway, Hope RF 95 LORA Transceiver, LoRa, LoRaWAN

I.INTRODUCTION

Low Power Wide Area Network is an open standard with low power, low cost used for long range IOT application. consists of LoRa which is a PHY Layer Implementation with bandwidth of about 867-868 MHz in India and has a bit rate of 0.3 to 50 kbps. It has a unique modulation known has chirp spread spectrum which is more advance than chirp spread modulation. Semtech and LoRa Alliance plays an important role. LoRa PHY layer consists of Semtech which is an open standard and a member of LoRa Alliance [1]. LoRa Wan which is a MAC Protocol owned by LoRA Alliance. Semtech consists of LoRA Transceivers. Hope RF is also like semtech which consists of LoRA transceiver. Lora has high band width which has in band and out of band Interference with resistance to fading. LoRa has Long Range capability with enhanced Network capacity. It has better Link budget. Link Budget is a measure of all gains and losses between transmitter and receiver. LoRa consists of various applications such as it can be used in Autonomous vehicles, Agriculture etc. LoRaWAN which is used for deploying public and private networks with low energy. It is more similar to cellular network. LoRa security based on AES encryption with Message Integrity code. LoRa consists of two keys Application session key and Network Session key which used as key management. LoRa network can be accessed using Over the Air Activation Method(OTAA) [2]and Activation by Personalization Method(ABP). OTAA consists of join request where as ABP implemented without any request. The Things Network is used as a Gateway

II.PHY AND MAC LAYER OF LoRa

LoRa is a PHY layer implementation which consists of band width and spreading factor. LoRa Spreading Factor Ranges Between SF7 to SF 12. End devices which [3] are close to network server has less spreading factor which are farther has high spreading factor. Date rate is also based on spreading factor. Data rate is calculated as Data Rate=SF*BW/2^{SF}*CR. Table 1 Shows about spreading Factor

Mode	Bitrate(kb/s)	Sensitivity(dBm)
FSK	1.2	-122
LoRa SF=12	0.293	-137
LoRa SF=11	0.537	-134.5
LoRa SF=10	0.976	-132
LoRa SF=9	1757	-129
LoRa SF=8	3125	-126
LoRa SF=7	5468	-123
LoRa SF=6	9375	-118

Table 1 Spreading Factor

LoRaWAN is a more energy consumption MAC layer which consists of Gateways and Enddevices. Things Network is used as Gateway between End nodes and Network server. IP connections are used between gateway and Network server. Adaptive data rate is used in Lora. Sensors are mainly used in LoRA and it has star to star Topology. Fig 1 shows about LoRa Architecture[5]

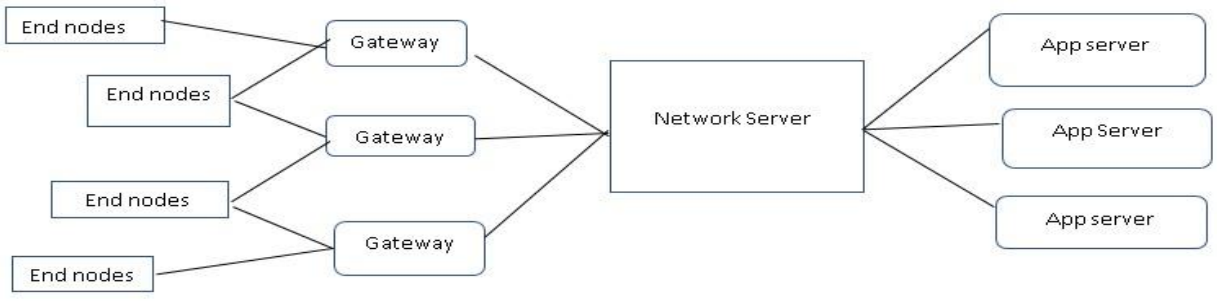

Fig 1 System Architecture of LoRa

LoRaWAN consists of class A, class Band class LoRaWAN has several different classes of end-point devices to address [4] the different needs reflected in the wide range of applications:Bi-directional end-devices (Class A): End-devices of Class A allow for bi-directional communications whereby each end-device's uplink transmission is followed by two short downlinks receive windows. The transmission slot [7] scheduled by the

end-device is based on ALOHA-type of protocol.Bi-directional end-devices with scheduled receive slots (Class B) devices open extra receive windows at scheduled times. It receives a time synchronized Beacon from the gateway. This allows the server to know when the signal gets from End devices. Bi-directional end-devices with maximal receive slots (Class C): End-devices of Class C have nearly continuously open receive windows, only closed when transmitting. Fig 2 shows about LoRA MAC layer [9]

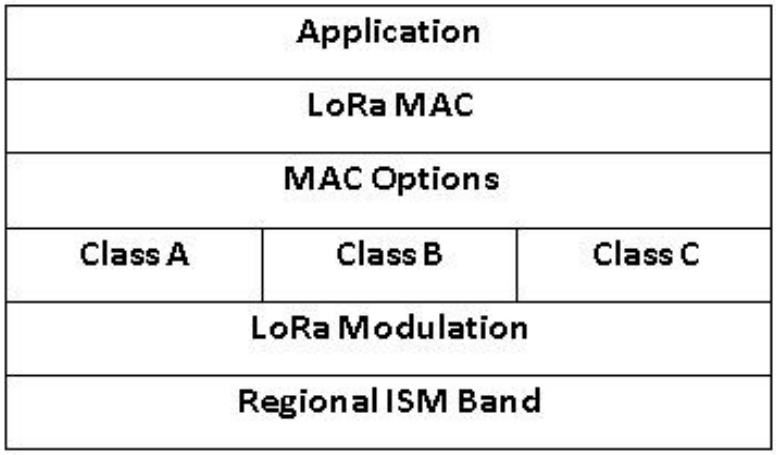

Fig 2 LoRa MAC Layer

III.CREATION OF GATEWAY

Gateway creation using LoRa Transceiver is simple and of low cost. The Things Network plays an Important role in creation of Gateway. Wiring Pi and single channel packet forward are used for Gateway creation. HopeRF 95 LoRA transceiver and antennas are used. Noobs is installed in Raspberry Pi Model 3 which consists of in built Raspian.Configure the Raspbian using the Raspbian configuration module. Peripherals are interfaced. AfterInterfaced kernel will be loaded. Wiring Pi which is used as tool. It is also installed. Single channel packet forward code is updated and a Gateway id is found. Register the gateway using The Things Network. In Things Network Website Gateway is registeredeasily. Messages will be sent using Single channel Gateway [10]. Fig 3shows connection of jumper wires with HopeRF LoRa transceiver. Then LoRa Transceiver are connected to Raspberry Pi in fig 4Thus a Gateway is created and they are showed in fig 5. which is of low cost with high robustness and is more efficient. Gateway consists of Gateway Id used to detect the End devices. [11] Connections are made using female jumper wires. The things network is more reliable and helps to register a gateway. It is based on ABP method where there is no need of join Request. It mainly consists of Application and Network session key. Message Integrity code is created. Encryption is also based on AES Key management is more effective while creating a single gate way. HopeRF 95[12]plays an Important role in creation of Gateway which acts as the transmitter and the receiver. Raspberry Pi Model 3 consists of Inbuilt WIFI. Hence it is easy to create a single channel gateway

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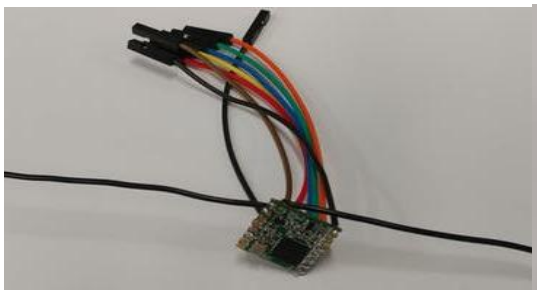

Fig 3 Connection of Transceiver

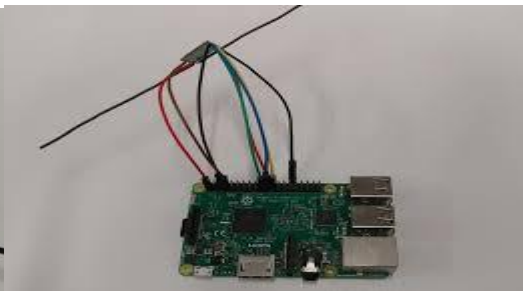

Fig 4 connection of Raspberry Pi 3

```
"metadata": {
  "time": "1970-01-01T00:00:00Z",   // Time when the server received the message
  "frequency": 868.1,               // Frequency at which the message was sent
  "modulation": "LORA",             // Modulation that was used - LORA or FSK
  "data_rate": "SF7BW125",          // Data rate that was used - if LORA modulation
  "bit_rate": 50000,                // Bit rate that was used - if FSK modulation
  "coding_rate": "4/5",             // Coding rate that was used
  "gateways": [
    {
      "gtw_id": "ttn-herengracht-ams", // EUI of the gateway
      "timestamp": 12345,              // Timestamp when the gateway received the
message
```

Fig 5Creation of Gateway

IV.CONCLUSION

A single channel Gateway is created using loRa.They are more efficient and robust than other wireless network. LoRaWAN plays an important role for MAC layer implementation. Chirp spread spectrum which are used in RADAR applications is used in LoRa which is more advance and effective. LoRa s spreading factor ranges from 7 to 12 which is used to calculate Signal Noise Ratio and coding Rate. LoRaWAN as an LPWAN technology that provides wirelessconnectivity within long ranges using very low energy. Sensors are used which are of low cost. LoRa can be used in Autonomous vehicles, Automated meter Reading and Long-Range Irrigation systems. LoRa is based on wide spectrum modulation which is more efficient and has high bandwidth. The data rate is also high. It also provides Inherent Robustness. Thus, LoRa is far better than all wireless network which consumes low energy and mainly uses chirp spectrum modulation. My future work will be on detection of Traffic signal and Pedestrian crossing in a virtual bed Environment using Low Power Wide Area Network. It can be Implemented in Autonomous Vehicles Which consumes less power and they are of low cost. LoRa will be more Energy consuming and has higher efficiency. Things Network is used mainly for creation of Gateway by personalization method. Hence a single channel Gateway is created and Implemented using LoRa, Low power Wide Area Network which is very cheap and has high robustness against Interference

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