Lorawan: A Communication Protocol For Remote Monitoring Applications

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Abstract:

Low power wide area networks (LPWA) are the choice of remote monitoring application in recent technological era. This technology has brought a phenomenal change as far as wide area covering and power consumption are concerned. Although there are many of communication protocol exists like Zigbee, Sigfox, WiFi, BLE etc, LoRaWAN is one of the most efficient protocol we have. In this article, we have shown various approaches to integrated LoRaWAN with remote monitoring application. The architecture of the LoRa along with its technical details have been illustrated. Hardware and software platforms are used for simulation purpose.

Keywords: LoRa, IoT, LPWAN, Agriculture,Smart city, traffic monitoring, smart lighting

1. Literature Review:

Low-Power Wide Area Networks (LPWAN) now gaining a lot of attention because less power usages. It is so popular in industry, academia and day today applications [1, 2].This approach has the potential to transmits the information in wide range i.e in in kms without any wire and also capable of interacting thousands of IoT devices for communication without human interference [3, 4]. Applications such as smart city, smart waste management, smart light, smart parking, smart farming etc are becoming easier with this technique. [5–6]. LoRa is battery operated on low power can be interfaced with multiple sensor and actuators to sense and control the appliances respectively [7]. It is predicted that by 2020 more than 50 billion devices will be interconnected with each other for data transfer. Technology like LoRa, NBIoT are more reliable due to its advance features over other communication protocols [1]. This article presents a literature review of fifty suitable article, where the application area, categorization of LoRa and finally some recommendations are provided for the uses of this network.Where researcher could have idea to develop solutions using LoRa on IoT platform [6]. The revolution of future technology like 5G also came in to the as far as the communication with a great speed is concerned. Now a day's communication protocols are being designed to prevent security issues. LPWAN playa very crucial role

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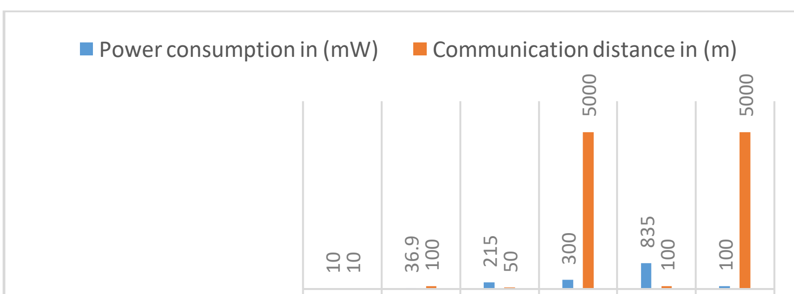
to eradicate these kinds of issue related to security [12].A multi hop LoRaWAN based architecture has been developed for the underground automation. Challenges including blind spot detection, where there is no signal has been identified and solution has been given to eradicate these connectivity issues in it [13].The worldview of Internet of Things (IoT) is making ready for a world, where a considerable lot of our day by day items will be interconnected and will interface with their condition so as to gather data and computerize certain assignments. Such a dream requires, in addition to other things, consistent validation, information protection, security, strength against assaults, simple arrangement, and self-support. World population will be nine billion by 2050. Many challenges are faced due to less land and demand of agricultural product increment. So, agriculture farming technique need to be replaced by modern technique in order to achieve this goal[14]. This paper surveyed various articles on suitable agriculture monitoring technologies for precision agriculture using IoT platform. Cloud based technique has been discussed for sensor monitoring and control [17].

2. Introduction

LoRaWANstand for Long Range wide area network. It is one of the most popular communication protocols used over others like BLE, WiFi, Zigbee, NBIoT etc. Figure 1. Show the details analysis between distances covered with respect to the various communication protocols. LoRa uses ADR(Adaptive data rate) technique to transfer data. ADR helps to maintain battery life. Although the data transmission rate is from 20 Kbps to 200 kbps, but the distance coverage is more. It has been proved with experimental validation that, LoRa could be able to achieve wide area up to 30 to 35 Kms with line of sight communication. Figure 1. Shows the power consumption details in mW. LoRa takes the advantages from others



	BLE	Zigbee	Classic BT	LTE	WiFi	LoRa
Power consumption in (mW)	10	36.9	215	300	835	100
Communication distance in (m)	10	100	50	5000	100	5000

Figure 1. Comparison popular communication protocols used day today

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2. Architecture of LoRaWAN:

The architecture of LoRa comprise of End node devices, Gateway, Network Server , Application Layer.

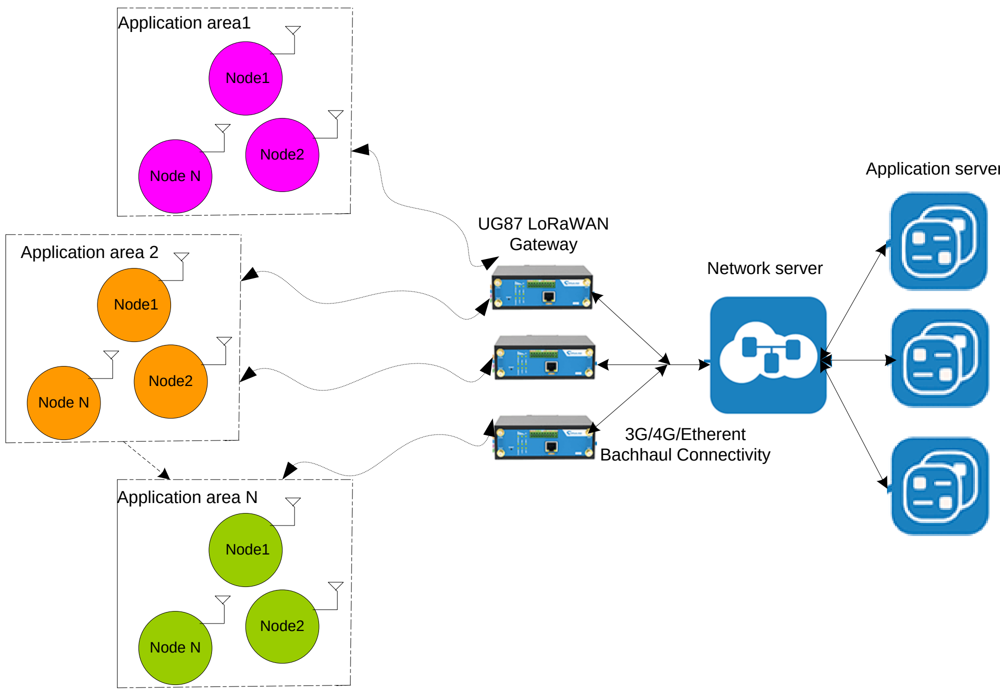

Figure 2. LoRa architecture

The above architecture shows, how Application layer, Network layer and MAC layer are coordinated in LoRa . Application layer comprises of all sensor end nodes deployed at field. Network layer helps to establish connection in between sensors nodes and LoRa gateway. Data gathered at LoRa Gateway. The transmission of data occurs in bits. Data transmission occurs in LoRa follow data frame structure mentioned in above figure 2. Preamble is the program code need to be transferred. PHY header mechanism applied to the data packets. CRC is the cyclic redundancy check take care of the same correct data bits received. Payload contain LoRa WAN or MAC data bits.

$$\boldsymbol{Symbol\ rate\ (Rs) = S.F * \frac{BW}{2^{S.F}}} \quad \textbf{(1)}$$

Transmission symbol rate in LoRa network calculated using following formula.Where S.F is the spreading factor in LoRa network. BW: Bandwidth in Hertz.

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Preamble	PHY header	CRC	Payload

Figure 3. LoRa bit framework

2.1 LoRa simulation platforms:

Simulator facilitate to simulate the

Platform	Uplink	Downlink	MAC Commands	Downlink traffic	Physical Model
NS3	YES	YES	NO	YES	All interface based
Python	NO	NO	NO	NO	Power difference based
C++	YES	NO	NO	NO	

Simulator features has been mentioned in Table 1. With respect to physical model designed in the simulator.

2.2 Hardware Platform:

A customized LoRa test bed has been designed to validate test code. Figure 4. Shows LoRa customized transmitter module. It has dedicated analog and digital pins to interface various sensors to it. It is treated as end device in reference to LoRa architecture. It is operated on rechargeable battery and can be deployed in to the agriculture field for field monitoring. The LoRa module has been fabricated with ATMEGA328P .PCB design for the same has been done pcb trace software.

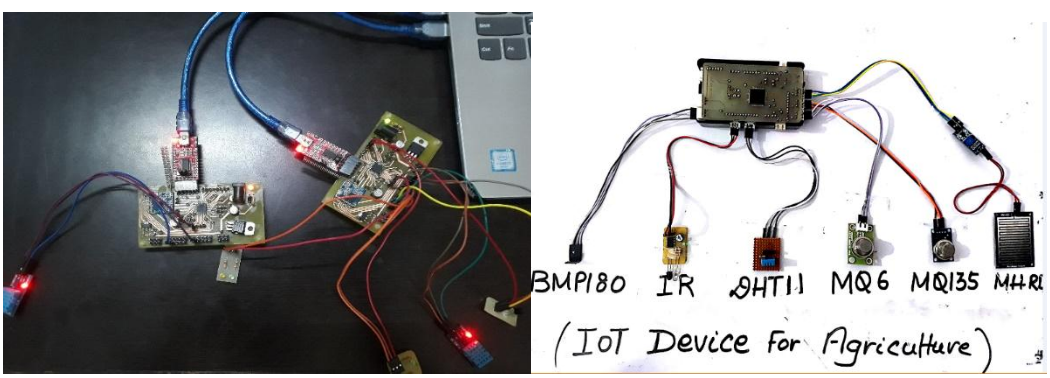

Figure 4. LoRa based hardware platform for agriculture application

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3. Result & Analysis:

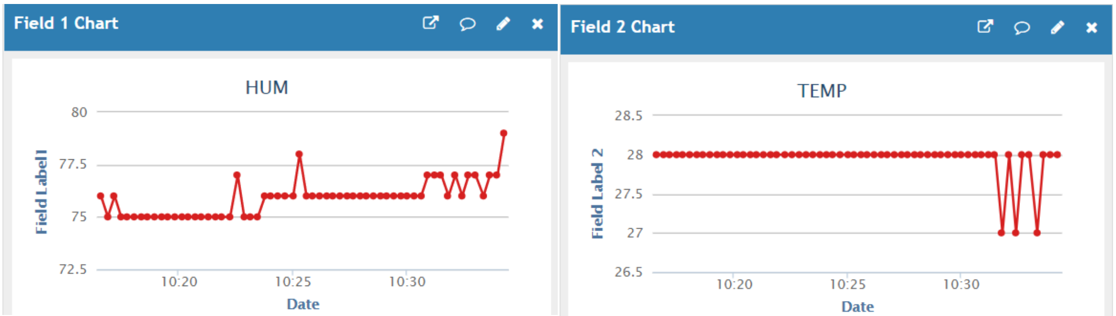

Figure 5. A web data logger showing all data gathered from agriculture land

Figure 6: A mobile data logger application

In Figure 5. Value of humidity and temperature have been displayed in a web page. Whereas Figure 6. Display the same information in mobile application interface. In Figure 6. There are control buttons can be used to control the actuators or sprinklers connected with relay at field.

4. Conclusion:

Long Range communication protocol is best fit for the IoT (Internet of Things) based application. We have fabricated customized LoRa based sensor nodes and receiver. Testing and validation have been carried out both in software and hardware platforms. The data gathered from the field have been recorded

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and send to cloud server for further analysis. We have discussed various approaches for integrating LoRa in to IoT to develop innovative solutions forSmart Building, Smart Lighting, Smart farming etc.

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