LoRa (Long Range) and LoRaWAN Technology for IoT Applications in COVID-19 Pandemic

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Abstract— **LoRa (Short for Long Range) is the fastest growing technology attracting researcher's interest now a days. Long battery life, long distance communication and low cost application specific devices are main focus of the engineers, LoRa is quite suitable for these requirements. IoT system includes four explicit sections for example sensors/devices, connectivity, processing of information and a user interface. The scope of communication has become the basic part on the majority of the IoT system, particularly in Wi-Fi and Bluetooth based IoT system. With the rise of LoRa technology, further enhancements to uses of the Internet of Things (IoT) can be figured it out. By utilizing a single receiver in the LoRa network, it can deal with numerous hubs at various areas inside the region, dissimilar to Wi-Fi-based framework which needs to have many access point to cover large area. Both LoRa and Wi-Fi innovation has reduced total cost of IoT framework. For the wide range coverage of IoT system, LoRa is quite useful as compared to Wi-Fi and Bluetooth for short range. However, there are a few inconveniences on the speed of transmission and constraint on the size of the payload. The world when struggling with the COVID-19 pandemic, LoRa devices and the LoRaWAN protocol are playing an instrumental role in enabling public safety solutions to assist with contact tracing, ensuring healthcare regulation compliance in the workplace and addressing the needs of medical professionals. This paper presents a specialized work on LoRa/LoRaWAN innovation for IoT applications.**

Keywords—LoRa, LoRaWAN, Internet of Things, CSS

INTRODUCTION

Internet of Things (IoT) is an arrangement of figuring gadgets, computerized electronic device, articles, creatures or individuals which are assigned Identifiers. Absolutely, without the need of PC or Human interactions, the information can be transferrable over a system by using wireless communications [1].

IoT grants physical items to think, watch, hear and to talk with each other to move data/information and to arrange decisions. These articles are being changed by IoT from being straight to savvy objects [2]. Long Range (LoRa) is the latest IoT communication innovations that works on LoRaWAN network protocol. Spread spectrum range modulation is basic platform for the LoRA technology which transfers the data & information over the long distance at lower exchange rate rather than the contending innovations [3]. The fast increment of embedded IoT devices has presented enterprises, organizations and individual customers to the improvement of included worth IoT applications. The prerequisites of a wireless IoT system are long battery life, with at least 10 years of battery term for basic day by day network with little parcels size, minimal price IoT module, low sending cost, through restricted new equipment establishments and site visits and full inclusion both indoor and outside. LoRa technology with low power consumption is capable to associate a great many sensors for the golden era of IoT.

I. LoRa/LoRaWAN Technology

For the application specific low power embedded system financially savvy Internet availability is a basic problem. When used for the low power, wide and low cost, the regular wireless communication technologies are lacking. Low Power Wide Area Networks (LPWAN) should work at low data rates to have wide range (In Kilometer) extend coverage from thick urban to rural districts. Various technologies like SigFox, LoRaWAN, NB-IoT & other sub-Hz innovations are effectively compatible with previously mentioned features, be that as it may, LoRaWAN technology came for the consideration of associations, networks, specialists and have grown as a well-known LPWAN technology [4].

Long Range (LoRa) is basically the wireless modulation to provide long distance transmission of data interface. Various inheritance wireless frameworks use FSK modulation for the top layer due to its advantageous performance for attaining low power. Long range (LoRa) works on chirp spread spectrum (CSS) technique, that maintain low power quality similar to FSK yet essentially extend the range of communication. chirp spread spectrum has been utilized in military and space correspondence for quite a long time because of the long communication separates that can be accomplished and vigor to impedance, yet LoRa is the primary minimal cost execution for commercial utilization. Low Power Wide Area Network like LoRaWAN then again are developed from ground. LoRa is created to work just with IoT gadgets which needs top tier battery life. LoRaWAN is intended for long-extend, low-power activity with sensors and controls that work off of batteries or vitality gathering gadgets. It has applications in transportation and

coordinations, brilliant structures, shrewd urban areas, and agribusiness.

Fig 1. LoRa having wide applications range in IoT system

LoRaWAN and LoRa Technology, essentially are not similar. For a particular device, LoRAWAN is actually media access control i.e. MAC which is above physical layer that controls the communication setup & architecture. LoRAWAN provides operating network for the LoRa devices.

II. CHIRP SPRED SPECTRUM (CSS)

Chirp spread spectrum (CSS) is the main platform available for the LoRAWAN [5].Researchers are focusing on this technology because it is incorporated by IEEE 802.15 standard with one of the two discretionary PHYs, CSS used specially in RADAR system.CSS is best suitable robust performance with very low power dissipation with small response delay and low path resistance. For the better execution CSS can be used with the digital modulation techniques such as BOK, FSK, BPSK & DQPSK. Chirp modulation was first presented by Winkler [6-8] in 1962. She recommended a parallel framework utilizing a binary system with inverse chirp rates.

III. LoRa Vs 5G

LoRa technology plays a vital role in communicate devices in wide area, this is the virtue of this technology.The communication area coverage accomplished by LoRa technology is noteworthy, no uncertainty. The capacity to transmit small amount of data in around 400 miles utilizing an only one passage is matched by no contending innovation. All things considered, is anything but an extraordinary fit for all innovations, due to either the constraints of the innovation or price of chips for new companies. Bluetooth, ZigBee and WiFi are the best communication technologies for the short range (within hundreds of meter) transmission & reception of data. There's additionally the quickening sending of 5G to consider. Design engineers are working on how 5G LTE will be used for the IoT communications system too. According to the LoRa Alliance's Moore: 5G & LoRAWAN can be used in various applications. Also 5G is best suitable for the high data transfer rate, low latency applications like emergency services, associated vehicles, and diversion "From our point of view, 5G and LoRaWAN are in a general sense fit to various applications," the LoRa Alliance's Moore said. "5G will be required for high data transfer capacity, low latency applications, for example, emergency services, associated vehicles with many more. Nonetheless, LoRaWAN suits for the wide are communications, additional battery life, long range & deep penetration through hard surface like cement and steel/Iron.

IV. LoRaWAN SPECIFICATIONS

There are a few key components of LoRa innovation including Long range: 15 - 20 km, Millions of hubs, Long battery life: more than ten years. The LoRaWAN features differs somewhat from area to area (Table I) in view of the distinctive local range assignments and administrative necessities. The LoRaWAN particular for Europe and North America are characterized, however different locales are as yet being characterized by the specialized panel. Joining the LoRa Alliance as a supporter part and taking an interest in the specialized board can have noteworthy focal points to organizations focusing on answers for the Asian market [9].Different region has different frequency band for LoRa. Europe and India using almost similar band of frequency.

TABLE I: LoRa/LORAWAN SPECIFICATIONS FOR DIFFERENT REGION [9]

	Europe	North America	China	Korea	Japan	India
Frequency Band	867-869 MHz	902-928MHz	470-510MHz	920-925MHz	920-925MHz	865-867MHz
Channels	10	64+8+8	In definition by Technical Committee	In definition by Technical Committee	In definition by Technical Committee	In definition by Technical Committee
Channel BW Up	125/250KHz	125/500KHz				
Channel BW Dn	125KHz	500KHz				
TX Power Up	+14dBm	+20dBm typ (+30dBm allowed)				
TX Power Dn	+14dBm	+27dBm				
SF Up	7 12	7 10				
Data rate	250bps-500kbps	980bps-21.9kbps				
Link Budget Up	155dB	154dB				
Link Budget Dn	155dB	157dB				

TABLE II: COMPARISION BETWEEN TECHNOLOGIES [9]

Feature	LoRaWAN	Narrow-Band	LTE Cat-1 2016(Rel12)	LTE Cat-M 2018(Rel13)	NB-LTE 2018(Rel13+)
Modulation	SS Chirp	UNB/GFSK/BPSK	OFDMA	OFDMA	OFDMA
Rx bandwidth	500-125 kHz	100 Hz	20 MHz	20-1.4 MHz	200 kHz
Data Rate	290bps-50kbps	100 bit/sec 12/8 bytes Max	10 Mbit/sec	200kbps-1Mbps	'20K bit/sec
Max. #Msgs/day	Unlimited	UL: 140 msgs/day	Unlimited	Unlimited	Unlimited
Max Output Power	20 dBm	20 dBm	23-46 dBm	23/30 dBm	20 dBm
Link Budget	154 dB	152 dB	130 dB+	146 dB	150 dB
Batery Lifetime- 2000mAh	105 months	90 months		18 months	
Power Efficiency	Very High	Very High	Low	Medium	Med high
Interference Immunity	Very High	Low	Medium	Medium	Low
Coexistence	Yes	No	Yes	Yes	No
Security	Yes	No	Yes	Yes	Yes
Mobilty/ localization	Yes	Limited mobility, No Loc	Mobility	Mobility	Limited Mobility No Loc

From the Table II it can be observed clearly that LoRaWAN data rate is quite higher than other technologies. Battery life time is also longer than that of others. All the important parameters like power efficiency, interference immunity are quite favorable in case of LoRaWAN technology.

V. OTHER NEW LPWAN TECHNOLOGIES

LoRaWAN is today's novel technology under LPWAN innovation. Narrow Band IoT (NB-IoT) is a cellular grade technology which is extensively increasing supporting more the cellular capacities. This feature can be used under low power consumption cost. It is more compatible with 4 G network. *SigFox* is the next performer in the field of IoT systems. This is actually the first company that innovate LPWAN on small bandwidth network. This technology is hardly used because it's only feasible for the research purpose only and also for low cost, small range radio modules [10]. *Helium* is a latest company which is working on the field of IoT communications. Helium has developed its own source LPWAN which is same as LoRaWAN.

VI. LORA APPLICATIONS IN COVID-19 PANDEMIC

The worldwide network is progressively going to Internet of Things (IoT) advances to support nations and urban areas give better network administrations to its populace. IoT system with adaptable, long-range abilities permit the medicinal services industry to create applications that streamline emergency clinics, patient care, and public health workflows through reliable and accurate data monitoring. Arrangement of smart human-body temperature observing instruments have been designed by Polysense Technologies utilizing Semtech's LoRa devices. Real-time information from the temperature sensors empowers health care officers to proficiently screen people with a high temperature. The temperature measuring instruments have as of late sent to the nations which are exceptionally due pandemic to help with its coronavirus (COVID-19) reaction endeavors. The infrared LoRa-based temperature sensors are playing vital role in different cities to provide better health monitoring and services to communities. IoT-based sensor technologies will become increasingly essential as a means to track and monitor such things as location, distance, and presence in the post coronavirus (Covid-19) era, according to the LoRa Alliance. Proofs and trials, which had struggled to make the business case for IoT before Covid-19, and have been curtailed in the short-term because of it, will be fast-tracked suddenly, as the pandemic has put a premium on automation and intelligence in work spaces and public spaces.

VII. CONCLUSION

With a large number of IoT vertical applications, LoRa devices and the LoRaWAN protocol is making business efficiencies and improving lives far and wide.

The COVID-19 pandemic has given the world phenomenal difficulties. Undertakings and government specialists are reacting by utilizing Internet of Things (IoT) advancements to adjust health and safety worries with money related contemplations while returning people to work. LoRa devices and the LoRaWAN protocol are playing an instrumental role in enabling public safety solutions to assist with contact tracing, ensuring healthcare regulation compliance in the workplace and addressing the needs of medical professionals.

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