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A Study of New Horizon on Emerging IoT Technology

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***Abstract* - Nowadays, IoT (internet of thing) has a great impact on emerging technology with the internet. There are number of IoT applications which used to make human's life easier. IoT can be defined as an electrical or electronic device. IoT devices have the capability to exchange the information between IoT devices as well as communicate with the global world. Generally, IoT devices are considered as a wireless device. Therefore the reliability, security and accuracy are the new areas of research on IoT Technology. In this paper, we have studied the various IoT communication technologies and compare their features.**

Index Terms: IoT applications, Wireless technology.

I. INTRODUCTION

Internet of Things (IoT) is latest technology. It interacts with physical equipment. Physical equipment has computing power and communication functionalities that can allow communication everywhere. IoT has wide range of applications in home appliances, Smart home, smart city, engineering, financial, and ecological systems etc. Internet of Things represents a common thing for the capability of network devices to intuition and assembled data from the world. For implementation of IoT wireless communication play very important role. Wireless network is network where devices are connecting with each other via radio frequency. In wireless network have various connecting devices such as Bluetooth, ZigBee, Z-wave, Wi-Fi etc. there are various network like Wireless Sensor Network, MANET, VNET etc. employed in IoT. In Smart city have good traffic management system, Garbage management system, Health system, ecological system, e-governance system. The existing systems are transforms into a smart though infrastructure based IoT devices. In this paper we present the communication device and compare their advantages.

II. IOT COMMUNICATION DEVICES

In communication technology there are many devices used for IoT like

Bluetooth: Bluetooth is small range, low power wireless communication device. In this device a trans receiver is used. The trans receiver transmits and receives the signal in 2.4 GHz bandwidth. It supports the data as well as voice channel and classified in IEEE 802.15.1 standard. Bluetooth uses a pairing process to establish encryption and authentication between devices. Bluetooth is used for point to point and multipoint communication. Data rate of Bluetooth device is approximately 24000Kbps. [6]

ZigBee: Zig-bee is low data rate and very less power wireless communication device. It supports number of channels as compared with Bluetooth for data. ZigBee device is classified in IEEE 802.15.4 standard and supports 884MHz to 2.4GHz bandwidth. Data rate of ZigBee is approximately 250 kbps. Zig Bee follow 16- bit CRC data protection and nominal range 10m.[7][8]

Ultra- Wide Band: Ultra-Wide Band is advance technology as compared to Bluetooth and ZigBee. It provides radio system having very high bandwidth 3.1GHz to 10.6 GHz in low power. It is classified in IEEE 802.15.3a standard. Two ways of generating useful signal with Ultra – Wide Band namely TM-UWB and DSC-WUB which include low duty cycle and high duty cycle wavelets. Ultra – Wide Band is up to 100 Mbps bandwidth. [9]

Z Wave: Z Wave is low power 2-way wireless technology designed and optimized specially for smart home applications and the internet of things. Z Wave lead the home control market, providing system that deliver comfort, convenient, safety and security. Normally used for wireless sensor network and home automation. Sigma Design is the organization who mainly work on Z Wave technology. Z Wave supports mesh network topology.It operates on radio frequency band in which device control battery power by the use of sleep mode on and off simultaneously. [10] [11]

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SigFox: SigFox is another low power technology used Ultra Narrow Band (UNB) technology which operates on less than 1 GHZ [12] band therefor able to maintain all power in small channel. SigFox provide duplex data communication mode. SigFox enable devices to send wirelessly very small massage which enhance battery life. SigFox works on global network so that it allows large scale network topology. SigFox uses Random Frequency Time Division Multiplex (R- FTDM) scheme and obey partially address security system.

LoRaWAN: LoRaWAN is low power Wide Area Network (LPWAN) work for wireless battery operated on global network. LoRa comes from its advantages of long rang capability. It is perfect suitable for IOT application that only need to transmit tiny amount of information in a long range. LoRaWAN operates in a non-licensed band below 1GHz for long rang communication link operation. [13] LoRa WAN network are organised in a star of star topology in which gateway nodes relay message between end devices and a central network server. LoRaWAN defines three types of devices (Classes A, B and C).[14] LoRaWAN specification includes three major components namely the PHY layer, the link layer, and the network architecture.[15]
Data rate is from 0.3Kbps to 50Kbps. [16] [17]

Wi-Fi: Wi-Fi is the technique in which two or more devices are connected using some standard network protocol and communicate with each other. Wireless fidelity (Wi-Fi) include IEEE 802.11 a/b/g standard for wireless local area network (WLAN). Wi-Fi has basically three types of wireless network namely peer to peer, wireless, personal area network and WiMAX. Wi-Fi has a frequency range up to 5.9 GHz[18] it uses BBS basic cell with range of 100-meter channel bandwidth of 54000Kbits/s.[19]

6LoWPAN: 6LoWPAN support IEEE 802.15.4 standards which have low power wireless network. 6LoWPAN is smaller than ZigBee or other protocol used typically 32K flash memory. Header overhead 2 to 11 byes and United States Department of Defense is developing several prototype 6LoWPAN networks to demonstrate Ipv6 mobility. These describe the PHY and MAC standards. It supports to short distance of wireless network from 10 to 100 m. 6LoWPAN support 2.4 GHz PHYs over the air data rates of 20kb optionally100 kb/s and 250kb/s.[20] It supports Mesh topology with low cast and low power consumption. Main objectives of 6LoWPAN is to provide facility of wireless sensor network. Because of Ipv6, 6LowWPAN support wider range of address with stateless address space which is easy to access. [21] [22]

III. LITERATURE REVIEW

Ruinian Li et al. [1] proposed a secure smart shopping system using Radio Frequency Identification technology. In smart shopping system they achieve the objective to identify items, item tracking and payment verification. This system has Zig-Bee device with microcontroller and ultra-high frequency employed in Radio Frequency Identification technology.
Samaresh Bera et al. [2] introduced a software defined Networking (SDN). In SDN network operators and users to control and access the network devices remotely. SDN generally have three-layer architecture application, control and infrastructure. They also presented basic requirements of IoT applications i.e. Network management, Network function virtualization, accessing information everywhere, resource utilization, power management, security and privacy.

Jie Lin et al. [3] investigated the fog/edge computing-based IoT. They discussed relationship between IoT and fog/edge computing as well as applications, including the smart grid, smart transportation, and smart cities, was presented to demonstrate how fog/edge computing-based IoT to be implemented in real world applications.

Panagiotis Sarigiannidis et al. [4] introduced an analytical framework for modelling security attacks in Internet of Things (IoT).

Andrea Zanella et al. [5] presented the IoT technology for smart city. They also discussed the number of applications such as waste management, noise management, traffic congestion, e-Health structure, City energy management etc. Apart from this we also study more number of papers on IoT technology. From literature review, we observe that technological improvement transforms the daily life style.

IV. APPLICATION OF IOT

Basic idea of IoT is to connect every virtually physical device to internet with the use of small intelligence devices. Basic application of IoT is to provide sensor network with low cost power consumption [23] in different fields like.

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Smart Home Construction: With the use of IoT devices and its technology we can make our homes very smarter. Smart in the sense that the device can be perform some task according to user's point of view. We can create a sensor network in our home connected to all devices in doors, window, and fire alarm etc. so that no any unauthorized person enters our home without prior permission.

Traffic Monitoring: Now a day traffic problem is very big issue in any country. IoT devices are able to manage traffic by sensor network. With the use of these devices we can easily to monitor our vehicle and its speed, also known which area is heavy traffic.

Air Quality: Now a day every person is suffering from environment pollution. With the use of sensor network IOT device are easily to show quality level of air which is very helpful for us.

Agriculture: IoT devices are very helpful for measurement greenhouse effect. It is a best example of IoT technology. Data like humidity, soil and temperature etc are collected in real- time so that the WAP (wireless application protocol) is guide the production.

Cloud Computing: IoT technology is enable to processing of data and extract valuable knowledge. It is very easily to synchronize and manage between general cloud service environment and IoT devices.

Energy Consumption: By the use of IoT devices and its technology we can easily save the energy in any city by enabling authorities and citizens to get a clear and detailed view of the amount of energy required by the different services.

Smart Parking: IoT technology and its devices are enable to make easily parking services by road side wireless sensor network. Smart cities Its make faster time to locate parking slot so that emission of carbon monoxide (CO) is less from the vehicle. IoT devices enable to electronic parking so that remove the traffic problems.

Health Care: Now a day so many apps are available which is track human body blood pressure and sugar level. IoT device gives the day to day information about health condition so that precaution is taken first before any critical problem occurs.

Garbage Management: User can also solve the problem of unhygienic condition and prevent from some deadly diseases and human illness by dropping smart dustbins around the city which is connected through the wi-fi network. IoT devices track the level of garbage bins so that user can clean waste material as soon as possible.

V. COMPARISON OF IOT DEVICES

TABLE I
COMPARISION AMONG VARIOUS IoTS

PROTOCOL → FEATURES ↓	Bluetooth	ZigBee	UWB	Z Wave	Sig Fox	LoRaWAN	WiFi	6LoWPAN
Standard	IEEE 802.15.1	IEEE 802.15.4	IEEE 802.15.3a	Z Wave Alliance AD 12837/ ITU-G9959	Sig Fox	LoRaWAN	IEEE 802.11a/b/g	IEEE 802.15.4
Typical Range (Meter)	10	100	10	100	100	20000	100	100
Max Data Rate (Kbit/s)	24000	250	100000	40	1	50	54000	250
Frequency(GHz)	2.4 GHz	2.4 GHz	10.6 GHz	0.90842 GHz	0.9 GHz	0.915 GHz	5.9 GHz	2.4 GHz
Security	Shared secret	AES 128	CBC-MAC	AES 128	Partially Addressed	AES 128	WAP 2	AES 128
Modulation	GFSK	BPSK(+ASK), OQPSK	BPSK, QPSK	GFSK	GFSK	GFSK	BPSK, QPSK	BPSK, OQPSK
Power Efficiency	High	Very High	Very High	Medium	Very High	Very High	Very High	Medium

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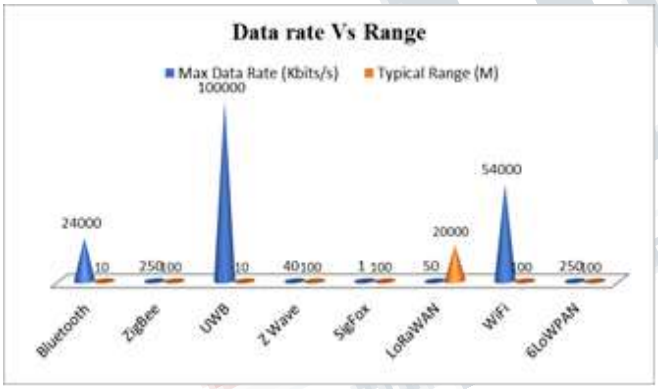
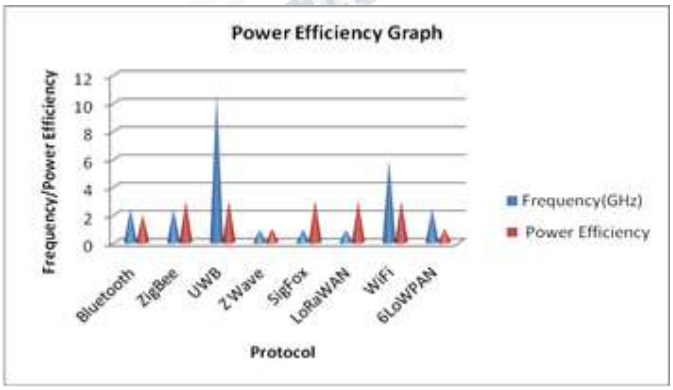
Scalability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Topology	Star	Mesh	Mesh	Mesh	Star	Star	Star	Mesh
Data Protection	16-bit	16-bit	32-bit	32-bit	16-bit	32-bit	32-bit CRC	16-bit
Spreading Technique	FHSS	DSSS	DS-UWB	DSSS	DSSS	CSS	DSSS	DSSS
Nominal Tx Power (dBm)	0-10	-92 - 0	-41.3	3.979	-129	20	15-20	3.483
Application	Wireless Connectivity	Smart Home Monitoring	Wireless Audio, Data, Video Distribution	Smart Home Monitoring	Energy Meter	Smart Lighting,	Wireless Connectivity	Smart Home Monitoring





Efficiency = Useful Power Output / Total Power Input

GFSK = Gaussin Frequency Shift Keying
FHSS = Frequency Hopping Spread Spectrum
BPSK = Binary Phase Shift Keying
DSSS = Direct Sequence Spread Spectrum
QPSK = Quadrature Phase Shift Keying
THSS = Time Hopping Spread Spectrum
OQPSK = Offset Quadrature Phase Shift Keying
DS-UWB=Direct Sequence Ultra-Wideband
CSS = Chirp Spread Spectrum
AES 128 = Advance Encryption standard
dBm = Decibel Milliwatt

VI. CONCLUSION

In this paper, we studied detail overview of exiting IoT technologies in the context of IoT applications. In our study an IoT environment consisting heterogeneous devices, which are both static and dynamic in nature, they are different frequencies, data rates, and modulation techniques etc. Therefore, we carefully served the most important aspect of IoT and compare the various IoT technologies, From the comparison table we observed that UWB has maximum data rate but less rang and less frequency compares to WI-FI. All IoT technologies have different pros and cons which is less power consumption and have maximum battery life. So, we cannot say specifically one of is best technology it depends on which platform is use. In future work, IoT will be extended to mobility model as well as its security point.

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