IJCSE International Journal of Computer Sciences and Engineering Open Access
Survey Paper Vol.-6, Issue-8, Aug 2018 E-ISSN: 2347-2693

A Survey of Wireless Communication Technologies in Internet of Things

M. Avatade[1*], M. Lal[2], A. Jain[3]

[1,2,3]Computer Dept, DYPIEMR, SPPU, Akurdi, Pune, India

[*]*Corresponding Author: monu13.engg@gmail.com, Tel.: +91-9175689638*

Available online at: www.ijcseonline.org

Accepted: 17/Aug/2018, Published: 31/Aug/2018

***Abstract*—** The main Motive of Internet of Things is to segregate everything in our world under a common controlled environment that will give us control of day to day life things, as well as providing us status updates of the things. In Accordance with this, Effective implementation of Internet of Things is completely depends upon Technologies and protocols incorporated to communicate between electronic devices and its controlling circuitry. This paper Introduces about basic standards and parameters of the various Communication technologies inculcated in Internet of Things. In this paper, we illustrated the survey of key technologies involved in the implementation of Internet of Things along with the wide application area where the Internet of Things will have major role. We also discussed about detailed comparison of different parameters of various wireless Communication technologies.

***Keywords*—** Internet of Things, Communication Technologies, Comparison

I. INTRODUCTION

Internet-of-Things is widely growing domain which is designed to interpret, process and manage resource through Internet-connected Environment. The resource can be defined as interactive type of software or hardware with fundamental characteristics.[1] Basic components of IoT implementation are wireless sensor networks, wireless communication protocols, controlling circuitry (Arduino, raspberry Pi), user interface on mobile or computer. The IoT devices should be based on low-cost hardware with effective communication protocol. In the Designing process of IoT system, Novel communication technologies that are able to maintain trusted interconnection with low computational complexity are required.[2,3] Wireless radio access technologies are used to link many interactive devices to IoT controlling circuitry. IoT system should be capable of handling higher number of peripheral devices, which leads to generate high data rate traffic on internet bandwidth. Spectrum sharing technique, cognitive radio and dynamic spectrum access facilitates to manage the increasing data rate traffic.[4] While selecting communication protocol for specific IoT based application, major task is to indentify appropriate frequency bands which in turns to development of efficient mechanisms to facilitate congestion free frequency bands for wireless communication systems. This paper presents wide survey of various technologies inculcated in IoT based on their major parameters such as Type of Network and topology, power consumption, speed of internet data, range of communication, applications, and cost.In context of large scale IoT domain, it is necessary not only to review existing communication technologies in detail, but analysis of their suitability is also an important issue.

II. TECHNOLOGIES INVOLVED

There are various technologies that can be incorporated in IoT environment, this paper comprises of following technologies in detail

1. Radio Frequency Identification
2. Near Field Communication
3. Machine-to-Machine Communication
4. Wireless Fidelity (Wi-Fi)/ WIMAX
5. Bluetooth
6. ZigBee
7. Z-wave

RFID: Radio Frequency Identification system comprises of two basic components: RFID reader and RFID tags. Tags are allocated to different objects which are characterized by specific address. Tags consist of electromagnetic fields, to hold information related to object in electronic format. RFID tag is system on chip with small impact antenna, which will read signal when the object comes in the proximity of the reader and returns information of object to reader. The RFID systems are adopted in many applications like observing the life cycle duration of a product, manage the inventory in the warehouse, tracking of things, tracking of animals, airport baggage tracking logistics, mobile payment, etc. RFID uses frequency band from 125-134.2 kHz and 140-148.5 kHz,

which is known as low frequency band, can have communication range up to 3meters

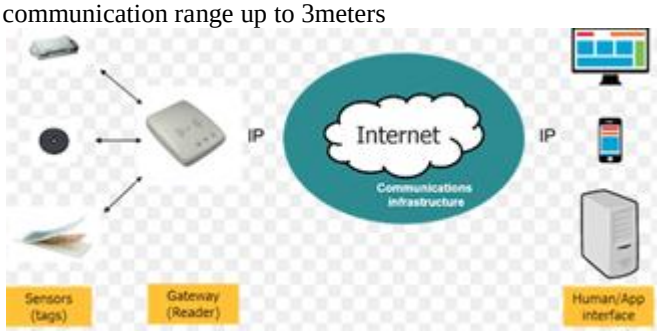

Figure 1. RFID system mechanism

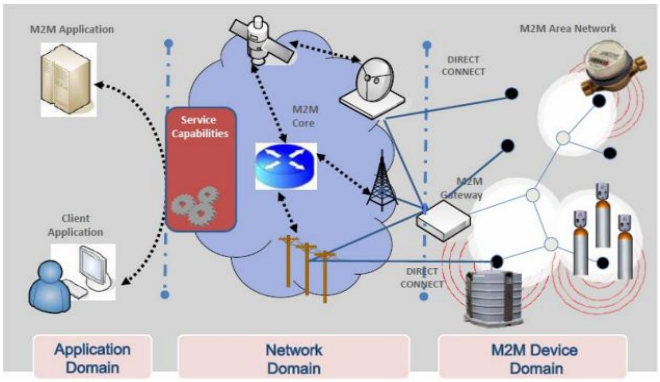

Figure 2. Working of M2M communication

Near Field Communication: Near field communication is designed to communicate between two devices kept in proximity of each other, It is next version of RFID that is able to handle small amount of data transaction between various devices. Circuit design of NFC is very similar to RDIF system, or it can be looked like RFID reader circuit incorporated in mobile phones, which makes it very user friendly because mobile is very popular electronic device. Another communication protocol widely used in mobile phone is Bluetooth, but unlike Bluetooth, NFC does not require pairing of devices prior to communication, also it takes very less power with data rate speed of 400kbps. NFC technology is suitable in future development of IOT, as it does not include any remote location control for communication.

Machine To Machine Communication: Machine to machine communication is having purpose of remote monitoring of devices, in which communication takes place between various remote sensors, it doesn't have any direct interaction with user. M2M technology is determined to automate decision making feature and communication process between two devices. There are four components included in architecture of M2M communication technology: 1] M2M device: which is capable of reacting to the data request sent by other devices in network. 2] M2M area Network: this provides network connectivity between M2M devices and M2M gateway. 3] M2M Gateway: it is setup that makes use of M2M features to ensure functionality of M2M devices.4] M2M communication networks: it is network to communicate between M2M gateways and applications.

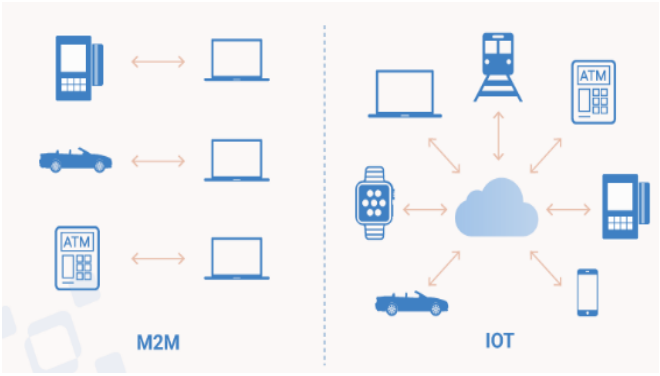

Figure 3. Difference between M2M and IOT Mechanism.

WiFi and WIMAX: Wireless Fidelity is technology defined for wireless local networking of devices under IEEE 802.11x standards, whereas WiMAX is defined under IEEE802.16 communication standards. The bandwidth used by Wi-Fi network is fixed to 20MHz, and for WiMAX ,it is variable from 1.25MHz to 20 MHz. WiMAX system comprises of WiMAX tower to cover large area for communication and a WiMAX receiver a device which is going to receive signals like laptop, personal computers etc. one location tower can be connected to other either by using high bandwidth wired connection or using microwave link with line of sight phenomenon.

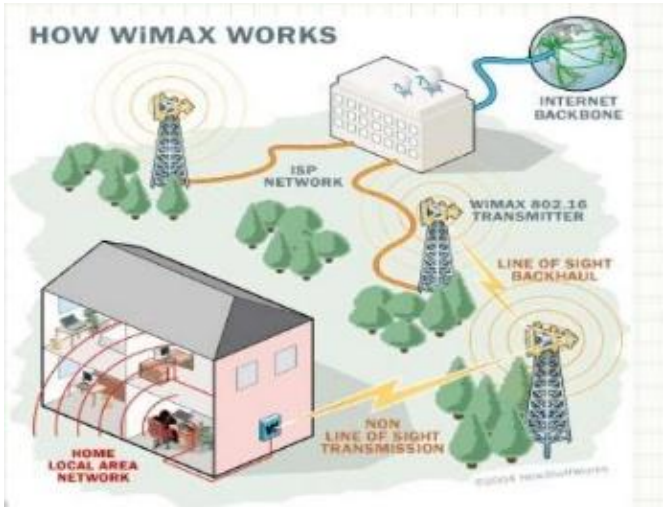

Figure 4. Working priciple of Wi MAX

Bluetooth: it is wireless protocol that establish connection between personal mobile phones, personal area networks. It uses short wavelength UHF radio frequency band from 2.4 GHz to 2.485 GHz. In Bluetooth 4.2, the next modified version, facilitates various internet connectivity options like smart gateway, IPv6 protocol, WPAN etc, which is essential feature while implementation of IoT. Some other features like security performance, energy efficiency, faster speed are also added to make Bluetooth smart, faster and efficient.

ZigBee: Zigbee is most popular wireless protocol used in communication. It operates on 2.4 GHz frequency band and facilitates speed of 250 kbps. It follows global IEEE 802.15.4 standards to control wireless sensor networks as well as wireless personal area networks. It can be easily incorporated into any IoT device through Zigbee gateways. Zigbee devices can be easily connected to each other to form their own network, as we are linking more Zigbee devices together; the communication paths between devices will increase, thereby eliminating the risk of single-point signal failure. Because of these aspects, Zigbee is ideal protocol to be used for home automation and efficient energy management applications.

Z-Wave: Z wave is communication protocol widely used in area of home automation. It uses mesh type network with low energy radio waves to communicate between various home appliances. Z-Wave is designed to fulfil the features like reliability, low-latency transmission of small data packets at data rates up to 100kbit/s. distance of Communication between two devices is about 30 meters and with message ability to hop up to four times between nodes, it gives more distance coverage for most residential houses. The throughput is 40kbit/s which is suitable for control and sensor applications.

III. COMPARATIVE ANALYSIS

Table 1. Comparison of IOT Communication Technologies

	RFID	NFC	Wi Fi	Wi Max	Bluetooth	Bluetooth LE	Zigbee	Z-Wave
Network	PAN	PAN	LAN	MAN	PAN	PAN	LAN	LAN
Topology	P2P	P2P	Star	Mesh	Star	Star	Mesh, Star, Tree	Mesh
Power	Very Low	Very Low	Low-High	High	Low	Very Low	Very Low	Very Low
Speed	400Kbps	400Kbps	11-100mbps	11-100Mbps	700Kbps	1Mbps	250 Kbps	40Kbps
Range	<3m	<10cm	4-20m	50Km	<30m	5-10 m	10-300m	30m
Application	Item Tracking	Pay, get access, share, initiate service	Internet, multimedia	Metro area broad band internet	Network for data exchange	Health & Fitness	Sensor network building, automation	Residential lighting & automation
Cost Adder	Low	Low	Medium	High	Low	Low	Medium	Low
Encryption	Possible	Possible	WEP, WPA, WPA2	128/192/256 Bits AES	56-128 bits	56-128 bits	128 bits AES	Triple DES

IV. CONCLUSION

In this paper, we presented the brief information of various parameters of communication technologies used in internet of things applications; we also elaborated its specification that can be used to make Internet of Things a reality. After that, we state some good examples where Internet of Things is of great use, and at last we compared technical specifications of all technologies, to make selection easier according to requirement of designer. With concern to comparative analysis of communication technologies, for long distance applications in IOT, Zigbee is suitable technology whereas for Wide area covering application which needs high power, Wi-Max is preferable Technology. As per as speed of communication is concerned, Wi-Fi is sustainable technology.

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Authors Profile

Mohini Avatade received B.E degree from and M.E degree from Pune University. She is Assistant Professor of Computer department in DYPIEMR,Pune.

Mily Lal received B.Tech-Computers degree from Calicut University and M.E-I.T degree from Goa University. She is Assistant Professor of Computer department in DYPIEMR,Pune.

Abha Jain received B.E-Computers degree from and M.E degree from Rajasthan University. She is Assistant Professor of Computer department in DYPIEMR,Pune.