

An Overview of IoE(Internet of Everything)

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Abstract— Digitalization brings a revolution in technical world and Internet of Things (IoT) plays important role in it. The extension of IoT in various fields leads to Internet of Everything (IoE). IoE connects individuals, processes, information and things in such a way that that the collective, arranged information are steadily used for various significant applications. Further, IoE found as a vision to aspire the innovative techniques in which internet of things, internet of nano things includes. When it is further focused on Internet of Everything, people will find a distributed system with improving limelight on the border during decentralization. Some of the results of IoE are used in digital transformation and business of IoT. While the IoT today fundamentally is drawn from the point of view of association and correspondence is based on conceivable outcomes. At last, the gadgets collect information which are investigated and utilized to control different procedures and power various potential of IoT based used cases. The concept of IoE is very new, it has many things to explore and utilize the power of IoE for better human kind. In this paper, it is tried to portray survey of IoE and its applications in various fields

Keywords—IoE (Internet of Everything), IoT (Internet of Everything), LoRa (Long Range), LoRaWAN, SigFox, LPWAN(low-power wide area network), decentralization,

I. INTRODUCTION

The termed Internet of Everything (IoE) is first coined by Cisco. The IoE is an idea that expands the Internet of Things (IoT) emphasizes on machine-to-machine (M2M) correspondences to depict an increasingly mind blogging framework that additionally includes individuals and procedures [5]. The Internet of Everything (IoE) contacts numerous parts of life. Few models are used in associated homes as well as in some urban communities. Sometimes these are used for vehicle tracking or on the street or gadgets that are used for understanding person's conduct etc. Moreover, these can be used for smart health services. In [1], they mentioned that the IoE has prospective to collect and survey real-time data from all the sensors interlinked to it and put in an application to supports" automated and people-based processes".

To make each and every work, smart companies started new technologies like LPWAN. LPWAN was developed to provide better lifecycles of batteries and to generate low-data rate traffic and it formed by combining LoRa and SigFox [11]. LoRa is a popular technology in this era which doesn't required any licensed below 1GHz for long-range communication link. SigFox is a small technology uses standard radio transmission method and have a bifacial direction.

The concept of IoE is very new, it has many things to explore and utilize the power of IoE for better human kind. Our contribution in this paper is to provide an existence information of IoE, and tried to portray survey of IoE and its applications in various fields.

As a last paragraph of the introduction should provide organization of the paper. Rest of the paper is organized as follows, Section I contains the introduction of IoE, Section II contains architecture of IoE, Section III applications of IoE in modern world which includes base application of IoE, Section IV contain challenges of IoE, section V explain comparison between LoRa and SigFox, Section VI concludes the survey of this paper.

II. ARCHITECTURE OF IOE

Internet of Everything (IoE) is the greater umbrella that includes the Internet of Things (IoT). The IoT refers to the idea of assigning computerized identifiers to ordinary articles, permitting lifeless things like wearable gadgets, home apparatuses, vehicles, and others to be remotely controlled for usability and comfort. The greater biological system of these keen things, when band together with information, procedures, and individuals, at that point it frames the idea of IoE. IoE is the extension of Internet of things (IoT) where IoE stands upon the "the four pillars" including People, Data, Process and Things, and IoT only

composed of things. Figure 1 shows that IoE stretches out to improve the lives of individuals. It is important to know the architecture of Internet of Things to setup Internet of Everything. Figure 2 gives the brief idea of an architecture of Internet of Things[3].

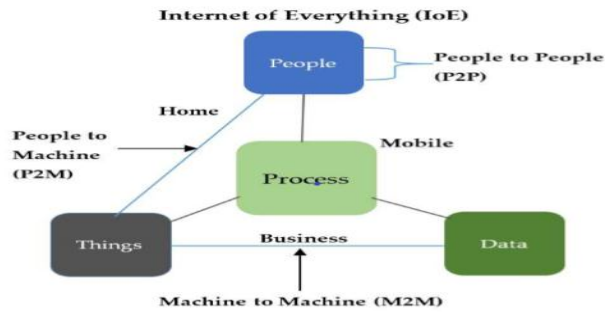


Figure 1: A sample diagram of IoE

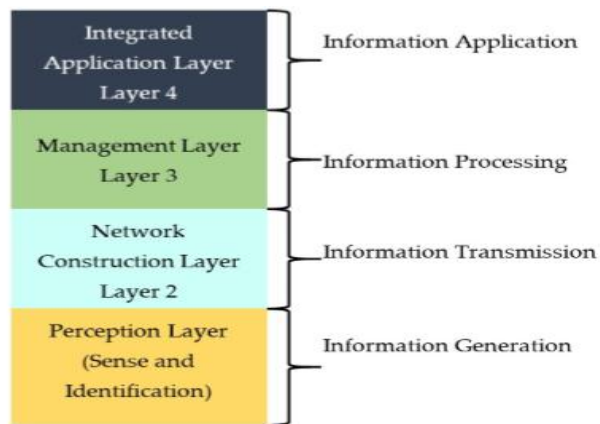


Figure 2: An four-layer architecture of IoT

The independent, non-arranged and detached gadgets of the past are currently being associated with the web including machine-to-machine(M2M), person-to-machine (P2M) and person-to-person (P2P) systems. This wrapping of persons, processes, data and things by IoE shown in Figure 1.

In Figure 2 four-layered architecture has been shown namely perception layer, network layer, processing layer, integrated application layer (collaboration of application layer and business layer) [5].

1. Perception Layer: Physical layer of IoT which includes sensors for detecting and collecting the data about the environment. It detects some physical parameters or recognizes other keen articles in nature.
2. Network Layer: This layer establishes a connection to other smart things, network devices and servers.

This layer also helps in data transmission and handling sensor's data.

3. Processing Layer: Processing layer reserves, examines, and operates large amount of data that comes from network layer. This layer manages and provide a different set of services to the lower layers. It utilizes numerous advances in databases, distributed computing, and huge information handling modules.
4. Integrated Application Layer: This layer composed of two layers one is application layer and another one is business layer. The application layer is in charge of conveying specific service application to the users. It describes various applications in which IoT can be sent, for example, smart health, smart homes, and smart cities. The business layer manages the entire IoT system, including applications, business and advantage models, and customer security.

III. APPLICATIONS OF IOE IN MODERN WORLD

Application of IoE varies from controlling different devices remotely with the help of Internet. In such situations, various hardware and software are controlled by machine learning program embedded in the specified devices [5].

IoE features fall under two primary classes:

- 1) Input: Through Input, it takes external data in terms of analog or digital format for specified hardware.
- 2) Output: Allows a piece of hardware to be put back into the internet.

Every single brilliant thing is a piece of the IoE. Brilliant gadgets, for example, cell phones, help frame a smart system that can be controlled or got to online under the IoE umbrella [1]. Many future scenarios that can be realized and many dreams can be true by the IoE which helps the world to become a dreamland. IoE includes smart systems for homes, cities, vehicles, personal fitness, safety, agriculture, wearable, automotive, smart roads, smart parking, smart lightening, Smart digital gadget detection, traffic congestion, waste management, air pollution, early earth quake detection, forest fire detection, swimming pool management and many more. A few notable are as follows [4]:

1. A smart indoor regulator that wisely alters the temperature.
2. Door locks that you can control remotely over a Bluetooth association.
3. Smart lights that can be controlled with a cell phone application.
4. Helps in remote monitoring and sensing of mining fields before further exploration. Thus it can provide extra security as well as accuracy in the mining field.
5. A wristband that utilizes your pulse to pay for staple goods.
6. Building and home mechanization get to control, light control, energy optimization, predictive maintenance, connected appliances.
7. Smart Cities - Pipe leak detection, traffic management, smart street lights, residential E-meters, surveillance cameras, centralized and integrated system control.
8. Wearables – Fitness band, smart watches, entertainment, location & tracking etc.
9. Healthcare – Remote monitoring, drug tracking, ambulance telemetry, hospital asset tracking, predictive maintenance.
10. Automotive – Wire replacement, telemetry, car to car and infrastructure, predictive maintenance.
11. Smart Manufacturing – Real time inventory, employee's safety system, firmware updates, flow optimization, predictive maintenance.
12. Agriculture – Automatic weather forecast, improvising the yield, plant irrigation, crop monitoring, nutrients etc.
13. Smart Grids - The behavioural study and analysis of consumption of electric energy by the consumers as well as energy supplied by the suppliers in automated fashion helps to improve the efficiency, reliability, and economics of electricity.
14. Developing of self-driven cars.

A few instances of decentralization developments in which IoE logically fits [7].

1. Fog networking also known as fogging, is a type of edge recording system in which IoT data can be transformed to the point of beginning, consequently accelerating things and solidifying up data transfer capacity and different assets in non-conveyed examination.
2. When it comes on cybersecurity, it is just moving away from standard consolidate prospect to a decentralized approach by which security appears as near as possible to the endpoint. It is not only about Internet of Thing but also about cybersecurity which are nowadays a major issue among the portable clients. Cloud-based computing to large extent has already achieved the security in this issue.
3. In document capture and data capture, there is a transformation from customary methodologies to distributed catch representations and combined approaches by which conventional method for halfway

digitizing records in a single place is clearing a path for distributed representations wherever they feel suitable.

IV. CHALLENGES OF IOE

The concept of IoE describes various factors including data and processes via which whole world can be connected with large distributed network. The IoE neatly sets a significance on the output, from where maximum changes can be seen in business models to gain large number of advantages from interconnected space. The high quality of adaptation and interoperability requires to view in IoE for smooth running [5]. It becomes a challenge for implementation. In [3], it is mentioned that they have focused on the scope and scale of increased 5G technology and handling of environmental challenges of IoE like underwater communication. Internetworking of frameworks will acquire consideration where registering and correspondence assets will be cut and collected so as to offer virtualized services at a global scale. But to make it more adaptable, there should be a need of flexible scheme of implementation.

In [1], Authors have mentioned some more challenges such as reduction of energy consumption in IoT devices so that it increases lifeline of devices. Through IoE energy harvesting process, it tries to empower the IoT devices in minimal time, increase ethical standards and hardened the devices so that the data of device should be more secured. If any kind of misbehaviour showed by the devices then appropriate data can be retrieved from it and analyse the data for further action.

V. COMPARISONS BETWEEN LORA AND SIGFOX

LoRa is a derivation of chirp spread spectrum modulation (CSS) which is a branded spread spectrum modulation scheme. To achieve the goal of LoRa, LoRaWAN network adaption technique with many channel and modem transceiver to receive a number of messages through the channels in the base stations [11]. LoRaWAN developed by the LoRa Alliances is an open standard [12]. LoRa consists of the physical layer of LoRa specifications and a network protocol of LoRaWAN. LoRa can operate 868 MHz ISM band and single transmission can range from 2-255 octets of payload and data rate can reach 50kbps in employed channel aggregation.

SigFox uses very small band also known as Ultra-Narrow Band (UNB) modulation that enables remote gadgets to connect an access point. In SigFox the gadgets start a transmission by sending three uplink bundles in grouping on three irregular transporter frequencies. The base station will effectively get the transmissions are lost owing to e.g. crash with different gadgets or impedance from other framework utilizing a similar recurrence. It can transmit 36 secs per hour because its duty cycle restricted in the band 868 MHz ISM

by 1% [10]. Its spectrum is divided into 400 channels of 100Hz [10]. At data rate of 100bps and payload size 12 octets a single end-device sends up to 140 messages per day. SigFox can tolerate millions of end-devices covers 30-50 km area in rural and 3-4 km area in urban [12]. Table I shows a comparative analysis of both LoRa and SigFox in terms of various parameters. It is observed that application of LoRa is more than SigFox for both technical and non-technical reasons.

Table I. Comparisons Between LoRa and Sigfox [9]

Network features	LoRa	SigFox
MCL [dB]	157	160
Bandwidth [kHz]	125	0.1/0.6
Transmit [dBm]	14	14/27
Spectrum [MHz]	868	868
Band	ISM, unlicensed	ISM, unlicensed

VI. CONCLUSIONS

In this survey paper, it is tried to present a survey of the current technologies used in the IoE by taking the base as IoT domain as of 2018. IoE is the concept in which the virtual world of information technology connected to the real world of things and established a connection to individuals by sharing the data. IoE is the future communication strategy of this world that could be defined as a dynamic global network infrastructure with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual 'things' have identities, physical attributes, and virtual personalities and use intelligent interfaces, and are seamlessly integrated into the information network. There is a need of rectification for total implementation of IoE on the legal, ethical, security and social fields. In 2050, one new revolution of internet and smart world are the future vision of researchers. LoRa and SigFox is playing vital role to give IoE a new direction to make a beautiful, smart and advance world.

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Authors Profile

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