



# Comparative Analysis of Location Based Technologies Inorder To Develop IOT Applications

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**Abstract:** Improvements in information and communication technologies have led to the development of Internet of Things (IoT). The Internet of Things is an emerging topic enabling everyday objects to communicate and exchange information from anyplace. Similarly, as a fast improvement in information technologies such as wireless communication and internet, location based technologies including Near Field Communication NFC, Radio Frequency Identification RFID, and Bluetooth Low Energy BLE have turned an engaging subject to researchers, organizations and commercial enterprises. Use of these technologies in IoT applications is beneficial for businesses, industries, environment and society.

This paper consolidates the information on the state-of-the-art Internet of Things abbreviated as IoT, from its structural design, system architecture and hardware requirements, to its standards and protocol stacks. This paper presents an insight into various location based technologies and highlights the proposed services to be provided by these locations based technologies. This paper also makes a comparative analysis of various location based technologies in terms of power consumption, range, cost, data transfer rate and accuracy.

**Keywords:** Internet of Things (IoT), Bluetooth Low Energy (BLE) Beacons, Proximity marketing;

## I. INTRODUCTION

The TCP/IP protocol suite known as Transmission Control Protocol and Internetworking Protocol defines the exchange of transmission, specifying how data is packetized, addressed, transmitted and received across the internet. The internet is the largest communication network of computers that spans the globe. The internet uses TCP/IP protocol that includes specification that identify individual computers to communicate and exchange data. Today, internet is steady in the lives of a large number of individuals around the globe; its range, usefulness and convenience appears to be limitless. The internet has changed the way many individual converse, shop, study, and work, socialize and do business [1]

Nowadays, everyday objects can be connected to the internet using IP known as Internet Protocol address and can sense, communicate and exchange information. Objects connecting with the internet can be computers, medical apparatuses, mobile phones, home appliances, automobiles and even cities equipped with sensors. The concept of connecting physical things to the internet using IP address is referred to as the Internet of Things (IoT), where items, objects connecting to the internet are assigned a unique IP address. Objects will be equipped with sensors and will be able to sense and communicate real time information about their environment and surroundings.

This paper provides an overview of various Location Based Technologies abbreviated as LBTs and presents a comparison among these technologies.

The rest of the paper is structured as follows. Section II gives an overview to IoT. Section III presents the concept of Location Based Technologies (LBS), Proximity, Proximity marketing, and how Proximity marketing happens. In Section IV various Location Based Technologies such as NFC, RFID, Wi-Fi, and BLE along with their application cases are described. Section V makes a comparison among various Proximity Based Technologies in terms of power consumption, range, cost, data transfer rate and security and Section VI gives conclusion.

## II. INTERNET OF THINGS

### A. Definition and Structural design

The word IoT is consisting of two terms "Internet" and "Things", where Internet is the universal network of computers that spans the globe. The internet uses TCP/IP protocols to connect devices worldwide, and Things refer to physical objects equipped with sensors and have the ability to sense, collect and communicate information around their surroundings. So, IoT is a system that spans the globe and that uses IP suite, where an object equipped with sensors has a unique identity, and that object works consistently and is

seamlessly incorporated into the data network by means of intelligent interfaces. An IoT system depend on an extensive variety of resources, internet services, network set-up, communication protocols and networking technologies [2].

In a Typical IoT system a device equipped with sensor also known as a sensing device by internet connectivity is deployed in the network, and that device is capable to send and receive data over the internet to arrive at a data center. By using internet services, end users will be able to control the device remotely. Also, end users have access to data center through the internet, they can collect, process and analyze data anytime from anyplace. IoT architecture consist of multilayers. Services-Oriented architecture is a methodology that has been used by scholars in the recent years for the implementation of IoT systems [3]. The layers corporate with each other by offering numerous services for instance sensing, communication, gathering, storing and records processing. There are some constraints of IoT devices and sensors such as energy and computational limitations. So, to provide interoperability between heterogeneous systems and seamlessly permit information exchange between IoT devices, numerous protocols and standards have been devised. Figure.1 depicts structural design of IoT system.

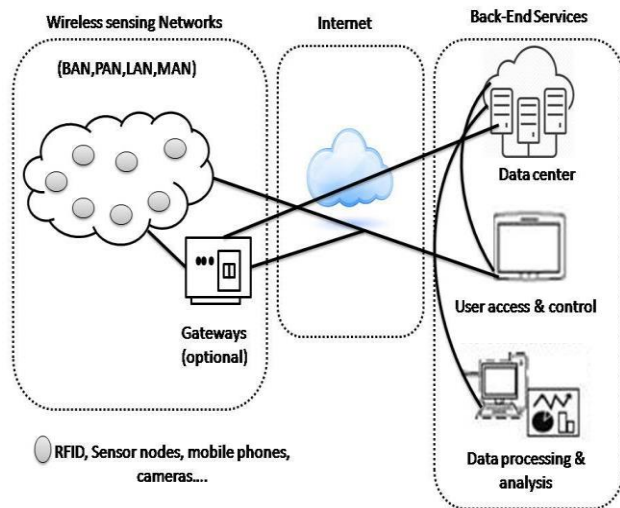


Figure 1. IoT System Architecture [1].

### B. IoT Standards and Protocol Stacks

The deployment of IoT paradigm is depend on IoT standards and protocol stacks for connecting small and low energy devices and for connecting a data stockbroker (agent) or an application. Numerous technologies are concerned in IoT organization, including Bluetooth Low Energy, Near Filed Communication, Radio Frequency Identification, Wireless Sensor network protocols, these all are used in IoT system. Beside these technologies several standards are being

established to handle interoperability issues and for exchanging data between the devices. IEEE 802.11, IEEE 802.15.4 for instance, are the utmost significant communication principles for deployment of IoT systems. Another important component of IoT paradigm is protocol stack, and one prominent amongst WSN protocols is known as Bluetooth Low Energy (BLE). BLE is an ultra-low power protocol for future IoT systems deployments. BLE is used in wireless personal area networks. BLE is best fitted to pervasive sensor networks [4, 5].

As explained earlier, the Internet Protocol is a common method of connecting nonhomogeneous networks and allow them to communicate and exchange data on the Internet. IoT system comprises of a number of physical devices each of which is linked to the internet; and each device has assigned a unique IP address. IP version 4 (IPv4) address which consists of 32-bit in length is used since many years to define uniquely a connection of a device to the internet. Because the quantity of devices, programs and applications connecting with internet are increasing rapidly. So to connect the expanding number of devices and applications with the Internet, IoT people organization has obtained the up and coming age of IP known as IP version 6 (IPv6). IPv6 address which consists of 128-bit in length for connecting billions of devices with the internet.

### III. LOCATION BASED TECHNOLOGIES (LBTs)

#### A. Overview of LBTs

While the Internet of Things (IoT) is gaining greater attention due to its potential and mobility. Location is becoming a very essential part of IoT paradigm. As said by TechTarget “Location” is a very important dimension of IoT paradigm that includes the ability of “things” to sense and communicate their geographic location. Therefore, location acts as an organizing standard for whatever thing connected to the Internet [6]. All these facts have created opportunity for development and adoption of Location-Based Technologies (LBTs).

Location Based Technologies also known as Proximity Technologies, utilize wireless communications, uses mobile devices, wireless networks and positioning technologies to transfer mobile communication and highly personalized, context-aware services to users. A smart-phone application has an access to a smart-phone's location services will offer navigational and in addition location-specific content, such as coupons or product reviews. These technologies have changed the way how people use mobile phones. According to eMarketer Inc, by 2019 there will be 2.5 billion smartphone users global. They'll use their cellular phones to navigate to restaurants, snap chatting their holidays, checking films playing at the nearby cinemas, or searching up products availability at area Wal-Mart stores. According to “Pew Research Center”, 90 percent of smartphone users are using

their phones for obtaining information associated to their location [1].

Companies are now starting to tap the location-based services (LBS) on consumers' cell phones with a view to send customer's related deals, commercial and advertising messages.

The elements of a Location Based Service (LBS) as shown in Fig 2.

*Positioning Technology:* Let's geographically localizing those mobile devices (cellular phones) both open air and indoor via: satellite systems, RFID, Bluetooth, Cell-id and remote LANs.

*Communication Network:* Is the wireless network to facilitate the transmission of information between client (through cell phone) and the server (i.e. server supplier).

*Service and Application Provider:* LBS provider includes software such as GIS as well as additional disseminated service and modules to facilitate the resolution of query and gives the personalized reply to the user.

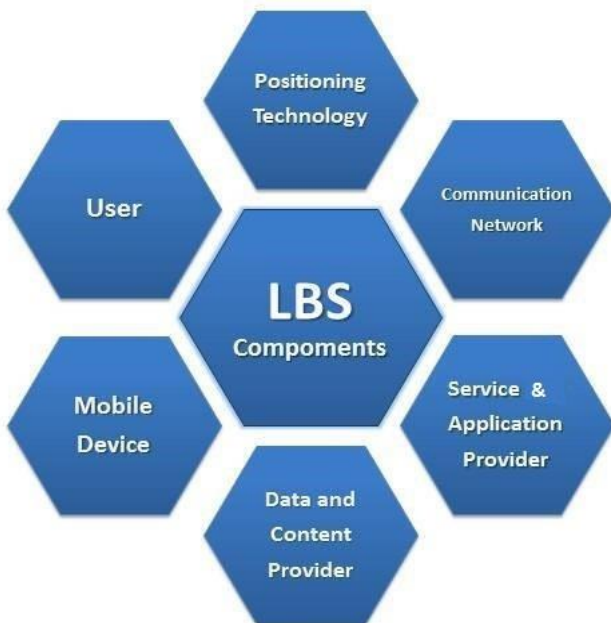


Figure 2. Elements of a Location Based Service

*Data and Content Provider:* LBS service provider generally does not store and retain all the information that the users request. So, geographic base data as well as location-specific information will be demanded from the keeping authority such as (mapping agencies) or else industry and business associates (for example yellow pages, traffic companies).

*Mobile Devices:* A portable device which uses the above stated LBS components, examples are smart phones, tablets, laptops etc.

*User:* Is any individual that uses the mobile device to obtain value added information.

*B. Proximity and Proximity marketing*

Consistently, new sort of innovation rise, these advancements are changing the way people interrelate with the world and with each other. The now famous “Internet of Things” (IoT). The IoT is a term for an assortment of advancements that defines various diverse approaches to connect physical things to the internet. As a result, anything becomes smart and context-aware, and offers very personalized experiences and collecting rich information about what’s happening in the real world. Another important concept in IoT is proximity. Proximity means detecting the presence of adjacent or nearby items or objects without any physical contact. In an idiom, “Proximity sensing known as Proximity detecting connects the digital world (cell phones) with the physical world (place or location)” [4]. Proximity implies knowing where your clients and resources are and cooperating with them in ways that are significant and meaningful. Furthermore, proximity implies that an IoT-enabled item or object responds, reacts and changes according to your location. For example, consider a smart home, you can “instruct” your home to adjust the lighting based on your first choice or preferences and time, however, would not it be better if the lights switched on automatically as you get into your room.

*C. Proximity advertising*

Proximity advertising is a form of marketing that makes use of mobile technology to transmit advertising and marketing messages referred to as proximity notification to mobile devices such as cell phones. In maximum instance people with mobile devices in a near proximity to an enterprise or business can get advertising messages or notifications. Proximity Targeting makes use of Bluetooth Low Energy (BLE) technology to send out messages electronically to nearby consumers. Proximity marketing is any system which uses proximity technologies to talk directly with consumers through their transportable devices. Examples of proximity advertising include sharing and circulation of media at live shows (concerts), facts, gaming and social applications, retail check-ins, payment gateways and nearby advertising.

*How Proximity marketing happens?*

The idea is that retailers, businesses, hospitality and consumer goods manufacturers embed a tiny chip such as beacons in their storefronts or products to transmit and broadcast messages to customers with Bluetooth devices. A

Bluetooth enabled device such as a smart phone can “see” a warning or notification once it is in range.

It makes use of BLE technology to recognize our location in a store and sends us notifications concerning things that will be sold we're inquisitive about. For instance, when you will come into range of a store you will receive a welcome message [7].

#### IV. ADDING PROXIMITY TO IOT APPLICATIONS

There are several ways to bring proximity to IoT applications.

Geofencing, NFC, RFID, Wi-Fi, QR codes, and Bluetooth have been adding proximity to solutions for years. The minute you enter a space, your cell phone rings with a message. Fig.3 shows proximity marketing

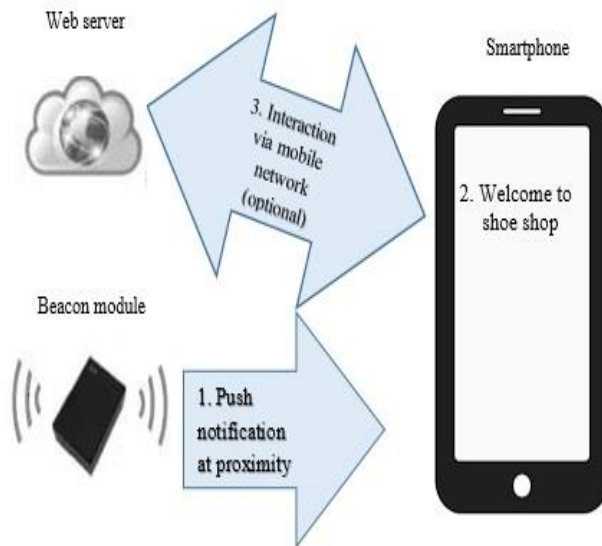


Figure 3. Proximity notifications [7]

#### Radio Frequency Identification (RFID)

RFID is a wireless communication technology that uses radio waves to recognize, perceive and track humans or objects. Another complicated narrative is an electromagnetic proximity (identification) identity and data exchange system. There are a number of approaches for identification, the most well-known of that's to relate the RFID mark or label or tag with an object, item, or person. This Technology makes use of 2-way radio transmitter-receivers to identify and track tags or labels associated with resources, assets or items. Similar to a barcode, an RFID label gives a completely unique recognizable verification code that can be read by a scanning device. Contrasting with other identification system, RFID make use of radio waves to converse with readers. When a reader gets these waves, it transforms them into digital data that identifies the objects that has the tag. RFID is used for

enormous type of programs starting from the acquainted building get entry to control proximity cards to deliver chain monitoring, toll accumulation automobile parking gets right of entry to manage, retail inventory management, pursuing library books, robbery aversion, vehicle immobilizer structures and railway rolling stock identification and motion monitoring.

Radio frequency identification (RFID) technology can be used in several environments, consisting of retail stores, warehouses and so forth, to keep track of various types of objects. RFID technology is used on a gasoline drift in industrial applications, to perform traceability of a bulk material flow [8].

This technology is also used to report drinking red meat farm animals water point use, farm animals visit times and time durations among visits to water factors [9].

Radio Frequency Identification (RFID) technology is used as a tactical device toward better overall performance of supply chain operations in fabric and clothing enterprise of Malaysia [10].

#### Near Field Communication (NFC)

NFC is a proximity identification technology which uses short range radio waves to provide communication between two cell phones which contain NFC labels or tags. NFC is established on the technology used for RFID. NFC is a specification for contactless communication between two devices. It connects the physical world we live and the virtual world. It permits items objects, persons, or place to be automatically associated with online documentation or Web content, therefore imparting useful correlated information that can be shown on nearby mobiles and computers. NFC communication is restricted to a distance between the two devices of up to 10 cm [11, 12].

We can do payment with our NFC enabled cell phone by swiping it out before the telephone reader and after that the price will paid automatically from Visa or check card. Our cell phone can be utilized as a part of place of wallet, Visas, debit cards and so on [13]. Museums and Monuments, for example, can introduce NFC devices to give visit data. Retail outlets can deploy NFC on racks for product information.

Near Field Communication NFC technology is used in implementing a secure server information handling system support. Secure NFC interactions with a server information handler, including a baseboard management controller, are supported with an NFC app executing on a smart-phone information handling system [14].

NFC conversation is used to explore and assess the learnability, usability, and excellent of interaction between the system and the children. The system is consisting of a table, holding an application with academic and training



purposes, prepared with a NFC reader, used to interrelate with user via objects [15].

### Wi-Fi

The term Wi-Fi refers to wireless fidelity. It is an IEEE 802.11 specification and is a wireless local area network (WLAN) technology standard. It works at the physical layer and a MAC layer, and allows devices to converse and talk via a shared or mutual access point within a short range (from a couple of meters up to 100 m). It enables clients to surf the web at broadband speeds once they have connection to an access point (AP) or on an ad hoc mode. Usually Wi-Fi uses radio waves at the air with wireless also called cordless communication between points. Wi-Fi provides connectivity between at least two points, they might be access point and customer or customer and customer (Ad-hoc Network). Wi-Fi permits overseeing or imparting system without laying links, it can decrease the cost of Links and laying charges. You can easily setup a communication network where you cannot lay the physical links. Wi-Fi setup and design is simple than cabling process, you can include any number of Wi-Fi customers without bothers and moving to other area [16].

An important feature of Wi-Fi is mobility, in a Wi-Fi network while you are within the signal range at workplace or at home you can send and receive data whereas you are moving. However, there is some point of confinement to exchange the information rate, it can't send the colossal information contrasted with wired network, information transmission rate affected by the network condition.

Because of increasing number of smartphone users in the world, it has become less difficult to identify location of any person. Wi-Fi based Indoor Positioning System using smart-phones are now commonly used to identify and track the of any person [17].

Monitoring fitness and health issues using Wi-Fi sensing and machine learning and Wireless Sensor Network (WSN) programs in Plantation Covering Areas are the emerging research fields [18, 19].

### Bluetooth

Bluetooth is an IEEE 802.15.1 specification, and is a low-power wireless technology standard. Bluetooth was created as an approach to trade information over a short range (like from your pocket to your shoulder) without the requirement for wires. That is the reason Bluetooth is used for remote headsets, without hands calling through your automobile, and remote record exchanges. Bluetooth innovation was initially intended for persistent, non-stop streaming information programs which includes voice and has effectively removed wires in numerous customer in addition to industrial and scientific applications. Conventional Bluetooth generation

will maintain to offer a strong wireless connection between wireless devices ranging from headsets and vehicles to commercial controllers and streaming scientific sensors [20].

Bluetooth technology is widely used in transportation studies to gather traffic information. Bluetooth enabled Media Access Control (MAC) readers may be mounted along roads to gather Bluetooth-based information. This information is often accustomed live traffic performance [21].

These days the employment of Internet of Things (IoT) technology has established that nearly all aspects in human's life use IoT to extend the standard of life. Smart system using Bluetooth technology such as Programmed gate, smart lock system for doors are the renowned Bluetooth applications [22] [23].

### Bluetooth Low Energy (BLE)

BLE is an ultra-low-power wireless technology standard established by Bluetooth Special Interest Group (BSIG). This technology was developed for short-range communication and for monitor and controlling applications that is anticipated to be integrated into billions of devices. It is a completely low power, noticeably short range (50m) technology that promises sensors to converse the usage of coin cell battery. This technology allows new programs and applications that were not realistic with classic Bluetooth technology. Coin cell battery-operated sensors and actuators in medical, business, consumer and fitness applications (called as Smart) can now easily hook up with Bluetooth low electricity era-enabled smart phones, tablets or gateways (called as Smart Ready).

Now a days, the technology keeps enhancing significantly, in particular on smart-phones. The consumer's requirements will increase each day. Shopping on line is in general desired by means of nearby everywhere in the world. However it is time consuming, to coup this problem online shopping is now expanded by BLE Beacon technology [24].

The key component of BLE innovation is its low power utilization that makes it feasible to control a little device with a modest coin cell battery, for example, a CR2032 battery—for 5– 10 years [25].

Like Classic Bluetooth BLE works at 2.4 GHz ISM band. However, because most of the time a BLE device remains in sleep mode and awakens only after a connection is initiated, the power consumption can be saved to a minimum, because the real connection time are of only a few mS. The most, or peak power intake is 15mA, and the average power utilization is of handiest about 1uA.

Bluetooth Low Energy BLE Beacons based Localization in indoor environments, Low-Cost assets tracking System,

building automation, activity tracking with BLE based networks, etc. are the BLE application areas [26].

*Zigbee*

Zigbee is an IEEE 802.15.4 specification and is a prominent amongst WSN protocol. ZigBee is considered to be a very energy efficient wireless protocol used in wireless personal area networks. It is best suited for pervasive sensor networks. It provides low price, ease of implementation, consistent information transmission, short range operation, very low energy intake and suitable levels of security [27]. Systems built on Wireless Sensor Network WSN platform that use ZigBee IEEE 802.15.4 can measure the data of crop parameters for the agriculturists, designed to improve the crops quality. The recommended systems can reduce the farmers’ exhaustive field visits [28].

V. PERFORMANCE COMPARISON

This section summarizes the main differences among the six protocols.

*Evaluation Factor*

In a really perfect world, we need a universally reachable location system that is extremely accurate, safe and economical. We are going to use these elements to evaluate each technology, as defined underneath.

*Frequency Band*

The Frequency Band in GHz range pertains to the velocity of a wireless network. The greater the frequency of a wireless signal, the smaller its range. For instance, 2.4 GHz wireless networks subsequently cover a significantly larger range than 5 GHz networks.

*Range*

Range mentions the distance a signal travels. For all the solution range depends upon the configuration, electricity settings and environment. For instance, a Bluetooth signal or a Wi-F signal can travel far further outdoors with no deterrent than in a multi-room, multi- surface indoor configuration. Further, it is conceivable to turn up the power to project a longer-distance signal.

*Accuracy*

Accuracy or correctness states the consistency of a signal inside a given range, and the tolerance of a signal while accounting for ecological components. For instance, BLE beacons when compared with Wi-Fi are more exact and precise indoors, due to the portable nature of beacon transmitters permits for configuration workarounds that

account for a signal refraction and bad reception zones (sources).

*Cost*

Cost refers to the cost or expense of setting up, utilizing and maintaining the system. While cost effectiveness is frequently with respect to the circumstances, less expensive is typically better while figuring return on initial capital investment when computing ROI.

*Security*

Security refers to the safety of data when sending data over a communication network or system and making it safe and immune to attacks.

*Power Consumption*

Power intake or consumption is the electrical power or energy supplied to operate an electrical appliance over time.

*Data Transfer Rate*

It is the speed at which data can be exchanged between devices. Often Data Transfer Rate are stated as megabits abbreviated as (Mbps) per second or megabytes abbreviated as (MBps) per second.

TABLE I. RFID VS. NFC

<i>Standard</i>	<i>RFID</i>	<i>NFC</i>
Specification Authority	IEEE Spec 802.15	ISO/ IEC 113157
Operating Frequency	Varies <sup>17</sup>	13.56 MHz
Bit rate	Varies <sup>17</sup>	106, 212, 424 or 848 Kbit/s
Directional Communication	One way	Two way
Rang	1cm-100m	5cm
Cost	High	Lower than RFID
Security	Less secure	More secure
Spreading	Varies <sup>18</sup>	GSMA
Potential Uses	Tracking items, EZ-Pass, Inventory Management	Information Sharing Contact less payment: e-Tickets, Credit card, Debit cards and other devices use NFC to make secure payments

As enumerated in TABLE 1. Near Field Communication abbreviated as (NFC) is an ISO/IEC 113157 standard, while Radio Frequency Identification is abbreviated as (RFID) is based on IEEE 802.11 standard. Both protocols use short

range radio waves for all type of labelling, tracking and pursuing process. RFID uses radio waves to recognize, identify and track objects or people, while NFC technology uses short range radio waves to provide communication between two cell phones which contain NFC labels or tags. NFC-enabled smartphones communicate with wireless transmitters (i.e. NFC tags). NFC operates at same frequency (13.56 MHz), while RFID tags fall into three sub categories as defined by their operating frequency.

*Low Frequency Passive (LF)* tags operate at 125 – 131 kHz and communication with LF readers using inductive coupling. Read distance for LF RFID is typical no more than a few inches. Typical applications for LF RFID include access control and animal tagging.

*High Frequency Passive (HF)* tags are based on ISO 15693 or ISO 14443, and they operate at 13.56 MHz. HF tags communicate with an HF reader using inductive coupling. Similar to LF tags the HF tags has a read distance of no more than few inches. They’re normally used to assist transit ticketing and library check in/take a look at-out packages.

*Ultra-High Frequency Passive (UHF)* labels or tags produce energy from an RFID tag that simulates the tag antenna to power on the chip. The tag at that point makes use of backscatter to ship data from chip hind to the reader. The read distance on UHF passive tags can vary a extremely good deal from just a few inches to over eighty feet depending on reader power and tag design. UHF is hastily turning into the de-facto preferred for deliver chain, retail stock, and asset supervision applications.

RFID broadcast rage up 100 meters, while NFC doesn’t work well for larger distance it is only better suited when two devices are close to each other (1-5 cm) [29]. NFC and can be set up for one- or two-way communications and can support maximum data transfer rate up to 848 Kbit/s. In contrast with RIFD, NFC system are less costly to setup, while RFID system are costlier to setup. As RFID tags can be connected to cash, apparel and possessions, or embedded in animals and people, the opportunity of reading personally-linked data without accent has raised serious privacy concerns. Also RFID brings up some security problems, an unauthorized device can read and modify data on tags, without the knowledge of the individual who has the object. On the other hand, using an NFC-enabled smartphone, viewers can access exclusive content and make secure payments.

As illustrated in TABLE II. Bluetooth and Wi-Fi both are wireless technology standards, both are the IEEE specification authority, and both operate at same frequency band (i.e. 2.4 GHz). Both technologies are used for wireless communication, however the difference between these

stems from what they are intended to do and how they are utilized. Bluetooth is mainly used to connect two or more nearby devices to send and receive information without using cables and when the speed is not an issue, for example phones, printers, modems, and headsets. It is better ideal for low-bandwidth applications like changing sound records with cellphone or byte data with the hand-held PCs or mice and keyboard. Wi-Fi technology provides high speed connection to the internet.

It is better suitable for setting up full-scale networks, since it allows a fast connection from the base station and better wireless protection than Bluetooth.

TABLE II. BLUETOOTH VS. WI-FI

<i>Standard</i>		<b>BLUETOOTH</b>	<b>WIFI</b>
Specification Authority		IEEE 802 .15	IEEE, WECA 802.11a /b/g
Operating Frequency		2.4 GHz	2.4 GHz
Bandwidth		Low (800 Kbps)	High (1 Mbps)
Rang		10 meters	100 meters
Cost		Low	High
Security		Less Secure	More Secure
Spreading		FHSS	DSSS, CKK, OFDM
Power Consumption		Low (less than 30mA)	High 116mA(1.8v)
Network Type		WPAN	WPAN/P2P
Modulation Type		TDMA	WPAN/P2P
Hardware Requirements		Bluetooth adapters on every device interfacing with each other	Wireless adapters on every device on the network, a wireless router or wireless access points
Ease of use		Easy to use. Might be used to attach up to seven devices at any given moment. It is easy to switch among devices or find and connect with any device	It is much complex to setup, and needs configuration steps to setup hardware and software

As illustrated in TABLE III. Bluetooth and Zigbee both protocols are based on the same IEEE specification (i.e. 802.15). Mainly Bluetooth is not better suited for long duration programs because of energy intake limitations.

Therefore, for small devices which require battery or limited energy supply for running another new protocol for information exchange we required that could oversee the

working with low power consumption. To fulfill these necessities a new protocol named Zigbee was introduced.

TABLE III. BLUETOOTH VS. ZIGBEE

<i>Standard</i>	<i>BLUETOOTH</i>	<i>ZIGBEE</i>
Specification Authority	IEEE Spec 802.15	IEEE Spec 802.15
Operating Frequency	2.4 GHz	868,915MHz, 2.4 GHz
Bit rate	1Mbps	250 Kbit/s
Rang	10 meters	30-100 meters
Cost	High	Low
Powerer Consumption	High	Low
Security	PIN, 64 BIT, 128 BIT	128 BIT, AES
Spreading	FHSS	DSSS
Applications	Bluetooth established applications are mostly in PC peripherals, for example keyboards, mo, headsets and so on. Likewise, some wireless remotes controlled devices use Bluetooth to interchange data.	Zigbee based systems are intended for wireless networking amongst sensors and is more favored for devices that are of smaller size and ingest a smaller amount energy. TV remote controls, clinical instruments etc.

Zigbee is a very energy efficient (low power) and low data rate protocol for setting up personal area networks, including home automation, medical apparatus data assortment, and different low-energy, low-bandwidth projects which require Wi-Fi connection. A Bluetooth network operates at frequency (2.4 GHz), while Zigbee operates at frequencies (868, 915, 2.4 MHz). A Bluetooth established network can be existent up to approximately 10 meters and can support maximum data transfer rate up to 1Mbps, while Zigbee exists from 30 to 100 meters in rage and supports data transfer rate up to 250 Kbps.

Bluetooth is used to exchange nearly all types of data at close range along with textual content and multimedia. Zigbee is not better suitable for exchanging much variety of data, it is specifically for operational instructions.

TABLE IV. BLUETOOTH VS. BLUETOOTH LOW ENERGY VS. WI-FI

<i>Standard</i>	<i>BLUETOOTH</i>	<i>BLUETOOTH LOW ENERGY</i>	<i>WIFI</i>
Specification Authority	Bluetooth SIG 802.15.1	Bluetooth SIG 802.15.1	IEEE, WECA 802.11a /b/g
Operating Frequency	2.4 GHz	2.4 GHz	2.4GHz
Bandwidth	800 (kbps) Low	(1 Mbps) High	(1 Mbps) High
Rang	10 meters	50 meters (150 meter in open field)	100 meters
Cost	Low	Very Low	High
Security	More secure than BLE	Less secure	More secure
Spreading	FHSS 1 MHz channel	FHSS 2 MHz channel	DSSS, CCK, OFDM
Power Consumption	Low less than 30mA	Very low 12.5mA	Low 12.5mA
Network Type	WPAN	WPAN/P2P	WPAN/P2P
Modulation Type	TDMA	WPAN/P2P	BPSK, QPSK
Hardware Requirements	Bluetooth adapters on every device interfacing with each other	With the low-power consumption of BLE, Applications can run on a small battery of about four to five years	Wireless adapters on every device on the network, a wireless router or wireless access points
Ease of use	You can easily create Bluetooth connections and pair devices to exchange documents, make hands-free mobile calls and even stream movies and music	Bluetooth Low Energy lets you to create easy to use wireless connections between any compatible iOS or Android devices to send Bluetooth beats.	It is more intricate and needs configuration of hardware and software



Bluetooth Low Energy abbreviated as (BLE) also known as Bluetooth Smart [16] is ultra-low power wireless technology standard for transferring information cordlessly. This technology was introduced for setting up wireless personal area networks. BLE has novel applications within healthcare, fitness, beacons, protection and domestic amusement industries. Compared to conventional Bluetooth, Bluetooth LE is supposed to offer substantially very low-power consumption and cost at the same time as keeping a similar communication range.

Wi-Fi and Bluetooth LE offer higher data transfer rate, while conventional Bluetooth offers a lower one. Bluetooth LE is meant for wireless personal area networks conversation approximately (100 meters), while Wi-Fi is intended for wireless local area network communication (approximately 100 meters). Unfortunately, Bluetooth LE's low power solution does not provide security that is up to the standards required by Federal Information Processing Standards (FIPS) regulatory guidelines. Not meeting these standards disqualifies Bluetooth BLE from use in certain industries that require the utmost security in the transmission of data wirelessly. On account of Wi-Fi tracing, cell phones of customers who have turned on Wi-Fi may be at the regular look out for Wi-Fi networks, which is then used by the retailers to detect the presence of nearby consumers and track their physical movements.

Pervasive also known as Ubiquitous Wi-Fi technology does no longer explicitly ask consumers for his or her permission, because it does not need any user involvement. Though, the only way out for consumer, is to totally disable Wi-Fi on their mobile device.

However, for Bluetooth LE beacons to track a customer, the customer has to turn on his or her cell phone's Bluetooth, permit location detection via the relevant app and opt-in to obtain in-store or indoor warnings or notifications. While Wi-Fi technology can assist industries and business companies to track more consumers, as it does no longer require them to install an app, it is best to select a technology that offers consumers full control over the information they're giving companies access to.

Wi-Fi technology can exactly point a device's accurate location through wireless access points, by calculating parameters such as MAC address and SSID. While Bluetooth LE Beacons do not discover a device's exact location they are all about proximity. Those proximity detection devices can detect mobile devices when they are in the stated range of the beacon, if they've the matching app installed on them.

The deployment of Wi-Fi and Bluetooth LE both requires retailers to plan in advance on where the devices will be located and to configure their positions in the software program operating these devices. Conversely, to [13]make Wi-Fi operational, you will also need to configure and

connect routers to an electricity supply (power source). While the cost of a router normally varies relying at the producer or manufacturer, getting a high-traffic router can be quite costly. Regardless of the differences among the two technologies, they work best when used collectively. For instance, at occasions wherever you want to be very certain of the location of the customer inside a venue, you can use Bluetooth LE beacons to address those proximity primarily based interactions. In the meantime, you can leverage Wi-Fi network to offer attractive navigational proficiencies and experiences within the venue and acquire analytics established primarily based on those customer movements.

## VI. CONCLUSION

In this paper, we assessed various Location Based Technologies in terms of energy consumption, range, data transfer rate, security etc. It is realized that there are numerous Location Based Technologies, so it is very difficult while choosing a solution.

As IoT is a technology that is in trend, a myriad of technologies are being evolved to satisfy all of the requirements from IoT community. Several Location Based Technologies for IoT communication have been proposed in the recent years to connect internet device, which enable them to sense and gather valuable information. The chief characteristics of those technologies are as follows.

Ultra-low-power consumption, offers a long life for sensing devices battery and increase network life. High data transfer rate from (250 kbps to 1Mbps). Short or long geographic and physical coverage (Zigbee/IEEE 802.15.4 standards, Bluetooth LE, low-power Wi-Fi). While there are numerous Proximity sensing technologies, the requirements can be different when selecting a solution to convert mobile communications and very personalized, context-aware services to consumers. So, a detailed evaluation and assessment of the desires and expectations should be taken into consideration alongside the performances and specific requirements of the application. Depending on the necessities in terms of geographical coverage (long or short range connectivity), information transmission rate, packet size, energy consumption, latency, bandwidth, and so on, there's a varied variety of new standards and protocols that are designed to meet the goal of overall performance and expectations of IoT-based systems.

## REFERENCES

- [1] G. T. Y. Tokognon, "Structural health monitoring framework based on Internet of Things: A survey," *IEEE Internet of Things Journal*, vol. 4, no. 3, pp. 619-635, 2017.
- [2] D. P. & A. Suresh, "A state of the art review on the Internet of Things (IoT) history, technology and fields of deployment. In Science Engineering and Management Research (ICSEMR), 2014 International Conference on (pp. 1-8). IEEE,," November,2014.

- [3] H. & L. Da Xu, "Internet of things in industries: A survey.," *IEEE Transactions on industrial informatics*, vol. 10, no. 4, pp. 2233-2243, 2014.
- [4] & F. P. (. Vermesan, "Internet of things-from research and innovation to market deployment," *Aalborg: River Publishers.*, vol. 19, 2014.
- [5] R. S. & B. Samuel, " A survey on big data and its research challenges," *ARPJ Journal of Engineering and Applied Sciences*, vol. 10, no. 8, pp. 3343-3347, 2015.
- [6] M. & G. Yick, "Wireless sensor network survey. Computer networks," *ARPJ Journal of Engineering and Applied Sciences*, vol. 52, no. 12, pp. 2292-2330, 2015.
- [7] N. & P. Allurwar, "Beacon for proximity target marketing," *International Journal Of Engineering And Computer Science*, vol. 5, no. 5, 2016.
- [8] H. & Ö. Sundberg, "Traceability of bulk biomass: Application of radio frequency identification technology on a bulk pellet flow.," in *Biomass and Bioenergy*, 2018, pp. 118, 149-153.
- [9] F. B.-H. & S. Williams, "Use of radio frequency identification (RFID) technology to record grazing beef cattle water point use," *International Journal of Computers and Electronics*, pp. 156, 193-202, 2019.
- [10] H. Ali, "Radio frequency identification (RFID) technology as a strategic tool towards higher performance of supply chain operations in textile and apparel industry of Malaysia 7(2), 215-226," vol. 7, no. 2, pp. 215-226, 2019.
- [11] R. Want, "Near Field Communication," *IEEE Pervasive Computing*, vol. 10, no. 3, pp. 4-7, 2011.
- [12] G. & K. Sharma, Near field communication., The Engineering and Management College, Dehradun, Uttarakhan: Department of Computer Science & Engineering Tula's Institute., 2013.
- [13] S. N. Jeon, "Ble beacons for internet of things applications: Survey, challenges, and opportunities.," *IEEE Internet of Things Journal*, vol. 5, no. 2, pp. 811-828, 2018.
- [14] A. & P. Taylor, Patent and Trademark Office., U.S Washington, DC, 2018.
- [15] B.R. Lorusso, "Exploring the learnability and usability of a near field communication-based application for semantic enrichment in children with language disorders.," *Assistive Technology*, vol. 30, no. 1, pp. 39-50, 2018.
- [16] N. Lee, "A comparative study of wireless protocols: Bluetooth, UWB, ZigBee, and Wi-Fi. In Industrial Electronics Society, 2007.," *33rd Annual Conference of the IEEE (pp. 46-51).*, 2007.
- [17] Y. U. T. & A. Sabanci, "WiFi Based Indoor Localization: Application and Comparison of Machine Learning Algorithms.," in *XIIIrd International Seminar/Workshop on Direct and Inverse Problems*, (2018, September).
- [18] W. Tan, Monitoring Health Using Wifi Sensing and Machine Learning., EngineerIT, 2018.
- [19] M. Siti Khairunniza-Bejo, Wireless Sensor Network (WSN) Applications in Plantation Canopy Areas, 2018.
- [20] P. Ferro, "Bluetooth and Wi-Fi wireless protocols: a survey and a comparison.," *IEEE*, vol. 12, no. 1, pp. 12-26, 2005.
- [21] & W. Yang, "Travel mode identification using bluetooth technology," *Journal of Intelligent Transportation Systems*, vol. 22, no. 5, pp. 407-421, 2018.
- [22] P. & H. Hadis, "Design of smart lock system for doors with special features using bluetooth technology.," in *International Conference on Information and Communications Technology (ICOIACT) (pp. 396-400).*, (2018, March).
- [23] Khreasarn, "Automatic gate using Bluetooth technology (Open the gate with the strength of the Bluetooth signal on the smartphone).," in *International Conference on Digital Arts, Media and Technology (ICDAMT) (pp. 54-58).* *IEEE.*, 2018, February.
- [24] C. M. Pugaliya, " Smart shoppe using beacon.," in *In 2017 IEEE International Conference on Smart Technologies and Management for Computing, Communication, Controls, Energy and Materials (ICSTM) (pp. 32-35).* *IEEE.*, 2017, August.
- [25] H. N. Siekkinen, "How low energy is bluetooth low energy? comparative measurements with zigbee/802.15. 4.," in *In Wireless Communications and Networking Conference Workshops (WCNCW), 2012 IEEE (pp. 232-237).* *IEEE.*, 2012, April.
- [26] Chou, "Application of Bluetooth low energy indoor positioning to optical lenses manufacturing factory.," in *In 2018 IEEE International Instrumentation and Measurement Technology Conference (I2MTC) (pp. 1-6).* *IEEE.*, 2018, May.
- [27] Somani, " Zigbee: A low power wireless technology for industrial applications.," *International Journal of Control Theory and Computer Modelling (IJCTCM)*, vol. 2, pp. 27-33, 2012.
- [28] Rahu, M. A., Kumar, P., Karim, S., & Mirani, A. A. (2018). Agricultural Environmental Monitoring: A WSN Perspective. University of Sindh Journal of Information and Communication Technology, 2(1), 17-24.
- [29] Bravo, "From implicit to touching interaction: RFID and NFC approaches.," in *In Human System Interactions, 2008 Conference on (pp. 743-748).* *IEEE.*, 2008, May.