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DESIGNING AND EXPERIMENTING THE INNOVATIVE, ALTERNATIVE AND COMLIMENTARY WIRELESS COMMUNICATION TECHNIQUE USED FOR THE IOT APPLICATION

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ABSTRACT

The advantages of wireless technologies over wired ones, such as simpler setup, cheaper frameworks, portability support, adaptability, and ease of connection, make them the greatest alternative for connecting IoT devices. Many varieties of wireless technologies exist for use in the Internet of Things, each with its own optimal operating range (from centimetres to kilometres). In this article, the Internet Engineering Task Force (IETF) presents the low power IEEE802.15.4 protocol and the ZigBee protocol, which was created by the combination of 6LowPAN and ZigBee (IETF). A sensor hub is a central point where data from a collection of sensors may be gathered and processed for use in wireless sensor network applications. Such nodes are often powered by batteries. Designed for use in the Internet of Things, these nodes can run for years without needing to have their batteries swapped out. Many ubiquitous everyday devices have been equipped with sensing, processing, and communication capabilities, hence increasing their utility by providing more data on which to base decisions. Internet-of-Things devices mostly interact with one another through wireless communication.

Keywords: Innovative, Wireless, Communication, Technique, IOT.

1. INTRODUCRION

The IoT, or Internet of Things, is a new computing paradigm that intends to transform commonplace items into high-tech ones through the use of the Internet. IoT has been identified as one of the problematic present-day technologies that will alter how we perceive, comprehend, and react to our surroundings. To connect and share data with other systems and devices through the Internet, actual objects, or "things," are increasingly being outfitted with sensors, software, and other technologies under the umbrella term "Internet of things." Developments in ubiquitous and irresistible computing, embedded devices, communication technologies, sensor networks, Internet protocols, and online applications are the fundamental unseen technologies that enable the smartening of everyday objects and, thus, the implementation of the Internet of Things. Therefore, these tools are sometimes referred to as enabling technologies for the Internet of Things. Communication protocols in technologies like 5G, RFID, Wi-Fi-Direct, Li-Fi, LTE, and 6LoWPAN have tremendously helped the potential of IoT, which has also made it more ubiquitous than ever before. As a result, IoT has been able to catch up with other fast-developing industries including detection, wireless revival, information trading, and handling. Though novel solutions are required, it is still debatable how these technologies, and especially the associated wireless communication protocols, can be closely aligned with IoT to increase their benefits on characteristics such as adaptability, administration quality, energy productivity, and cost viability. There is also a pressing need to investigate and address the myriad of intricate security and safety concerns.

2. WIRELESS TECHNOLOGIES FOR INTERNET OF THINGS APPLICATIONS

The Internet of Things (IoT) is a network of interconnected computing devices that may be used to monitor and collect data from physical systems, exchange that data via wireless communication with access points, and then transmit that data to a remote server or local edge device. Connecting IoT devices to the Internet creates an IoT ecosystem, which has the potential to enhance human lives. Climate and system performance in homes, cities, energy grids, cars, transportation, coordination, healthcare, and more will all benefit from this. Figure 1 depicts a few examples of emergent use cases for the Internet of Things. Despite the importance of wireless sensor networks (WSN) to IoT frameworks, IoT devices can operate well with little to no human oversight. A recent study by Cisco estimates that there will be 50 billion IoT devices linked to the internet by 2020. (2018). Different communication methods (wired, optical, and wireless) can be used to link a large number of IoT devices and to transfer data in backhaul network settings. Wireless technologies will be the greatest alternative for connecting such IoT devices because of its advantages over cable technologies, such as easier setup, less expensive frameworks, portable assistance, adaptability, and simplicity of association. Therefore, in this study, we will discuss wireless technologies exclusively.

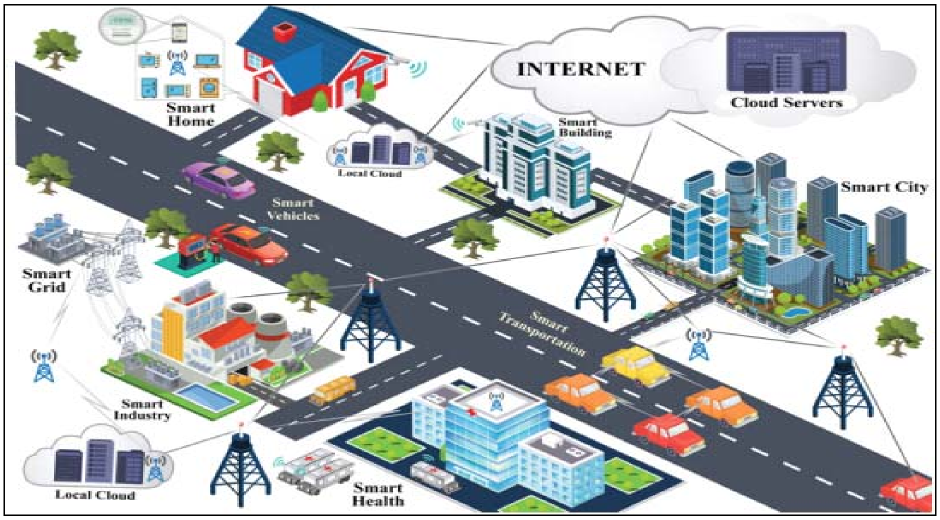

Figure 1: Emerging IoT application scenarios

Although all IoT gadgets exchange data and connect wirelessly, not all of them do it in the same way. There are many different kinds of networks available, and some of them are more suited to certain tasks than others. When deciding which option to utilise, you should think about things like battery life, range of inclusion, power requirements, and bitrate.

- **WiFi:** WiFi, or wireless Internet, is increasingly widely used as a method of connecting to the Internet. After its first release in 1997, the IEEE 802.11 WiFi standard had a number of verified revisions. The Institute of Electrical and Electronics Engineers has designated it as standard 802.11 and granted it support for operation at either 2.4 GHz or 5 GHz (IEEE). The standard maximum distance for most switches is 100 metres.
- **Bluetooth:** This is followed by Bluetooth. The small earbuds that let you use your phone hands-free have been around for a while, but today's technology is capable of so much more. Bluetooth is used in many kinds of devices, including ones used in medicine and industry (IEEE Standard 802.15.1). It uses the same 2.4 GHz frequency as WiFi but has key features that make it ideal for embedded use.
- **Zigbee:** While Zigbee (IEEE 802.15.4) is mostly used in industrial settings, you may also find it in certain commonplace items. It operates on the same 2.4 GHz frequency as WiFi, but at 250 kbits per second, it is significantly less powerful and is intended for much slower data transfers.

3. COMPETENT POWER CONSUMPTION WIRELESS COMMUNICATION TECHNIQUES FOR IOT APPLICATIONS

The Internet of Things, the third modern revolution, will be ushered in by a major change toward a broad linkage between each thing and processing (IoT). The sciences and technologies involved in this upheaval include data collecting, power consumption, wireless sensor networks, radio and mobile communications, data analysis and processing, and internet technology.

Consumer electronics, utilities, transportation, healthcare, and linked vehicles are just few of the numerous sectors that can benefit from the Internet of Things (IoT). The Internet is not being used to its full potential because of the rise of mechanical and daily necessities. The IoT is the candidate item to add new technologies to internet technology by enabling connections with and among smart things, with the ultimate objective of "whenever, anyplace, any media, anything." As a result, IoT should be considered a component of the future Internet, which will almost certainly look very different from the present Internet. Since the foundation of IoT is billions of smart sensors and actuators, it is crucial that we develop novel approaches to these components.

However, the first concern that must be resolved is the best way to wire all of these sensors and actuators together; Ethernet does not appear to be a viable option. Wireless networking is the only alternative since it offers the adaptability, low cost, and efficiency essential for the widespread use of IoT devices. Radio frequency wireless communication is the best answer for data flow in IoT architectures due to its large number of nodes and well-established infrastructure. When there is an issue with the power supply, the possibility of a wireless network connecting sensors is examined.

It would be ideal for Internet of Things applications if sensors could run for years on a single AAA battery. As a solution to the problem of limited power, IEEE 802.15.4 is the standard to which systems must adhere. In low-power local area networks, the IEEE 802.15.4 standard governs the wireless connection (LoWPANs). To create the ZigBee device, which is a low-cost, low-power wireless cross-section organising standard for remote control and monitoring, the ZigBee Alliance has embraced this standard. When deciding on a wireless technology for connected devices, a few factors should be taken into account as a rule of thumb based on the ultimate use.

- Maximum throughput
- Power consumption
- Maximum distance range

4. WIRELESS IOT CONNECTIVITY TECHNOLOGIES

There are a wide variety of wireless technology types that may be used for the Internet of Things, with ranges varying from centimetres to kilometres. Short- to medium-range communications should make use of Wireless Personal and Local Area Network (WPAN) technologies including Bluetooth, ZigBee, 6LowPAN, and Wi-Fi. Proposed Wireless Wide Area Network (WWAN) technologies for long-distance communication fall into two categories: those that utilise authorised (like future cellular 2G, 3G, 4G, and 5G) and those that employ authorised excluded technologies (LPWA LoRa, SIGFOX, and other). Connectivity is the backbone of the IoT, and the sort of access required will vary from application to application. Many IoT gadgets will be supported by radio technologies that employ unlicensed spectrum and are tailored for indoor or short-range communication with low quality-of-service and security needs.

4.1 Short Range Connectivity Technologies

With its recent advancements, Wi-Fi has become a fantastic replacement for ensuring connectivity in IoT applications, despite its much higher power consumption. Wi-Fi is now often available everywhere people need to exchange information or have conversations. However, Wi-conventional Fi's protocols really require quite a bit of energy, which is why it hasn't been very successful for sensor communications. This has changed since 2006, when the Wi-Fi community began introducing fundamental technologies like obligation cycling, which places devices in a rest mode for the vast majority of the time, and low power. The Microchips RN171 module is a standalone, embedded 802.11 b/g WLAN module with built-in light sensing capabilities. IEEE 802.15.4 is an excellent alternative for local area networks. IEEE 802.15.4 has been upgraded by a select few car radio manufacturers. Combining the ZigBee standard with the Internet Engineering Task Force's (IETF) low-power IEEE802.15.4 protocol has created a new wireless communication standard. IPv6 packet bundle transmission over IEEE 802.15.4 networks is detailed in detail by the IETF in a standard called 6LowPAN. This standard also details the required casing structure and a few additional components. In low-power LANs, IPv6 is referred to as 6LowPAN.

4.2 Long Range Connectivity Technologies

Presently, there are two alternative connectivity tracks for the numerous IoT applications that rely upon wide-area inclusion:

i. **Cellular Technologies:** Examples of 3GPP technologies include GSM, WCDMA, LTE, and the forthcoming 5G. These WANs operate within legal spectrum and have mostly honed down on providing high-quality mobile voice and data services. Narrowband IoT (NB-IoT) is a new radio access technology that is being developed specifically to provide an attractive response for emerging low power wide area (LPWA) applications..
ii. **Unlicensed LPWA:** For machine-type communication (MTC) applications targeting the super low-end sensor segment, with constrained demands on throughput, unwavering quality or QoS, new restrictive radio technologies have been developed and planned specifically for this purpose. Examples of such technologies include SIGFOX and LoRa. Sorting IoT apps according to their requirements for system integration and performance is one option (for example, data

speed or inactivity demands). Figure 2 depicts the many technologies usable for the Internet of Things (IoT) that fall inside the unlicensed spectrum and have varying inclusion areas.

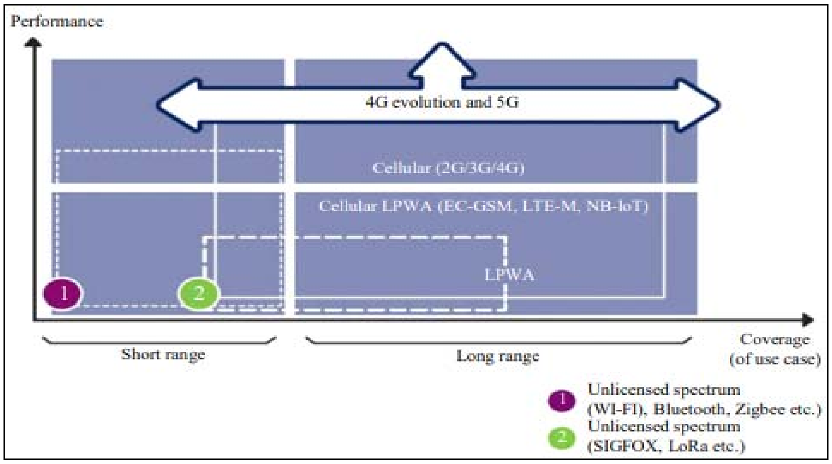

Figure 2: Technologies addressing different segments

Applications of cellular connectivity remain concentrated in traditional applications, for example, transportation, automotive, and location management. Cellular 2G connectivity gives the benefit of overall Nevertheless; there are limitations to cellular connectivity which LPWA addresses.

5. WIRELESS SENSOR NETWORKS FOR IOT APPLICATIONS

In applications using wireless sensor networks, sensors are typically clustered together to report to centralised nodes known as sensor hubs. The majority of these nodes rely on battery power. Hubs used in the IoT should function reliably for years without needing to have their batteries replaced. As a result, the expected lifespan of the sensor hub's batteries is the most crucial factor in the design of IoT sensors.

5.1 Used Module for a Certain Wireless Communication Protocol

5.2 Low Power Wi-Fi Modules for Short Range Connectivity:

The low-power Wi-Fi chip/module has an impact factor in diminishing the power consumption of battery used in Wi-Fi sensors. Low-power WI-Fi modules increase years of battery lifetime in same time they giving easy installation to existing Wi-Fi network without any extra gateway. New low-power Wi-Fi modules have been presented in the markets that help IEEE 802.11 protocols. The famous available low power Wi-Fi chips/modules in markets today are G2M5477 module from G2 Microsystem, RN171 module from Microchip, QCA4004 module from Qualcomm, GS1011M from Gain Span, RS9110-N-11-02 Module from Red pine and RTX41x arrangement Modules from RTX. A particular comparison between these modules in term of power consumption is illustrated in Table 1.

Table 1 Particular comparison for different low power Wi-Fi modules

Company	Module	IEEE Protocol	V_{DD} (Volt)	I_{TX} (mA)	I_{Rx} (mA)	Isleep (µA)	Max. Bit Rate (Mb/S)
Microchip	RN171	802.11 b/g	3.3	190	40	4	54
Qual Comm	QCA4004	802.11 n	3.3	250	75	130	10
Gain Span	GS1011M	802.11 b	3.3	150	40	150	11
G2 Micro system	G2M5477	802.11 b/g	3.3	212	37.8	4	11
Redpine	RS9110-N-11-02	802.11 b/g/n	3.3	19	17	520	11
RTX	RTX41x Series	802.11 b/g/n	3.3	0.760	0.760	3	10

5.2 Wireless Communication Protocols

a) **Comparison between Different IoT Protocols:** Table 2 summarizes the main contrasts between Low Power Wi-Fi, ZigBee, 6LowPAN and LoRaWAN protocols. This table has been filled according to the data sheet for each fruitful candidate module. According to the data appeared in Table 2, impact of distance between hubs on transmission power can be considered. Also, the impact of transmission time on power consumption can be examined.

Table 2 Main differences between protocols that may be used in IoT applications

Standard	Low Power Wi-Fi	ZigBee	6LoWPAN	LoRaWAN
IEEE spec.	802.11 b/g/n	802.15.4	802.15.4	802.15.4
Max Data Rate	10 Mbps	250 Kbit/s	250 Kbit/s	5468 bps LoRa Technology modulation
Nominal range	70 m^2 indoors and 225 m^2 Outdoors	10-100m	25 -50m	5-15km
Frequency band (GHz)	2.4/5	2.4	2.4	433/868 MHz
Nominal TX power (mW) dBm	19.95	52.22	2.23	Adjustable with Max. Value + 14 dBm

b) Transmission Time and Power Consumption: The time it takes for a message to go from one hub to another is determined by the data rate, the size of the message, and the distance between the hubs. Table 2 shows that ZigBee and 6LoWPAN protocols take more time to transmit than low power Wi-Fi does due to their low data rate (250 Kb/s) and their long range. LoRaWAN's low data rate necessitates additional time spent in transmission when used for long-range connection compared to short-range connectivity technologies.

6. CONCLUSION

The ability of the Internet of Things to track and control the weather has piqued the curiosity of nearly everyone. Numerous ubiquitous everyday devices have had their detection, processing, and communication capabilities expanded to provide more information to help in making decisions. One of the most important and essential aspects of every device in the Internet of Things is its capacity to communicate with other devices so that data may be shared and exchanged. Many Internet of Things gadgets exchange data with one another over wireless networks. Because different modules and protocols use varying amounts of energy, it is clear that the module configuration has a substantial impact on runtime. The transmission and reception maximum range is set by the modules and protocols in use. Since the impact of distance on power consumption differs depending on the kind of application, no one module or protocol may be a frontrunner for IoT use cases.

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