International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 05 Issue: 06 | June - 2021 ISSN: 2582-3930

A STUDY ON INTERNET OF THINGS (IOT) FOR NEXT-GENERATION SMART SYSTEMS

Sadhana Pandey
Assistant professor,
Department of Computer science and Engineering
SAGE university, Indore(M.P)

Abstract: *The Internet of Things (IoT)-centric concepts like augmented reality, high-resolution video streaming, self-driven cars, smart environment, e-health care, etc. have a ubiquitous presence now. These applications require higher data-rates, large bandwidth, increased capacity, low latency and high throughput. In light of these emerging concepts, IoT has revolutionized the world by providing seamless connectivity between heterogeneous networks (HetNets). This paper presents an exhaustive review for these key enabling technologies and also discusses the new emerging use cases of 5G-IoT driven by the advances in artificial intelligence, machine and deep learning, ongoing 5G initiatives, quality of service (QoS) requirements in 5G and its standardization issues.*

Key words: *Internet of Things (IoT), 5G, carrier aggregation, CoMP, CRAN, CRs, HetNets, ; smart grid; flexible demand; energy storage.*

I. Introduction

A wide variety of modern technologies such as communication systems (e.g., 5G), intelligent robots, and the Internet of Things (IoT) are expected to empower the fourth industrial revolution [4–6]. IoT interconnects a number of devices, people, data, and processes, by allowing them to communicate with each other seamlessly. Hence, IoT can help improving different processes to be more quantifiable and measurable by collecting and processing large amount of data [7]. IoT can potentially enhance the quality of life in different areas including medical services, smart cities, construction industry, agriculture, water management, and the energy sector [8]. This is enabled by providing an increased automated decision making in real-time and facilitating tools for optimizing such decisions.

Currently, new business models set for IoT implementation requires massive connectivity, high privacy and security, complete coverage, ultra-high reliability and ultra-low latency. The trending 5G enabled IoT encompasses increased data-rates, better coverage and high throughput hence providing solutions to business models and enabling IoT to robots, actuators and drones [7].

Over the past two decades, particularly the last 10 years, IoT has been a thriving area of research and development efforts, with a quickly rising body of produced research work. According to Microsoft Academic2 , there were only 26 publications on IoT in 2000 and 160 publications in 2009.

II BACKGROUND, MOTIVATION AND OVERVIEW

It is estimated that by 2025, the internet nodes may reside in every single object hence causing the number of devices connected to the internet to rise [8]. According to Cisco, there will be 500 billion devices connected to the internet by the year 2030. Similarly, Telefonica predicted in 2013 that 90% of the cars will be connected to the internet by 2020 [9]. However, the survey in 2015 suggests that more than 250 million vehicles will be connected globally by 2020, which will be an increase of 67% [10].

Based on the United Nations Sustainable Development Goals agenda [14], energy efficiency is one of the key drivers of sustainable development. Moreover, energy efficiency offers economic benefits in long-term by reducing the cost of fuel imports/supply, energy generation, and reducing emissions from the energy sector. For enhancing energy efficiency and a more optimal energy management, an effective analysis of the real-time data in the energy supply chain plays a key role [15]. The energy supply chain, from resource extraction to delivering it in a useful form to the end users, includes three major parts: (i) energy supply including upstream refinery processes; (ii) energy transformation processes including transmission and distribution (T&D) of energy carriers; and (iii) energy demand side, which includes the use of energy in buildings, transportation sector, and the industry [16].

IoT-based systems automate, integrate, and control processes through sensors and communication technologies. Large data collection and use of intelligent algorithms for real-time data analysis can help to monitor energy consumption patterns of different users and devices in different time scales and control that consumption more efficiently [19].

III. IoT OPPORTUNITIES AND PROSPECTS

Not only business opportunities, but also the realization of efficient and resourceful research opportunities to scholars and investigators of multi-disciplinary fields. Hence, it combines business studies, engineering skills, science and humanities all under one umbrella. In general, companies are going to take an immediate investment or a wait-and-see approach to investment based on the maturity level of the specific IoT technologies . During the initial deployment phase, the margin should be kept for adapting to changes. For this, open software and hardware-based IoT solutions should be proposed [12]. In this regards, one approach of cost-cutting is to use smartphones serving as IoT nodes [16].

The reason behind the interest of the first world countries in IoT trends and developments is its prevailed benefits. The outlined benefits hence proved advantageous for the country's economic sustainability, growth, urbanization, infrastructure, employment rate, citizens' health and services.

IV.Enabling Technologies

IOT is a paradigm in which objects and elements of a system that are equipped with sensors, actuators, and processors can communicate with each other to provide meaningful services. in iot systems, sensors are used to sense and collect data, and through gateways route the collected data to control centers or the cloud for further storage, processing, analytics, and decision-making.

A.SENSOR DEVICES

Sensors are the key drivers of IoT . They are employed to collect and transmit data in real-time. The use of sensors enhances effectiveness, functionality, and plays a critical role in success of IoT . Different types of sensors exist that are developed for various application purposes. The examples of these applications include agriculture industry, environmental monitoring, healthcare systems and services, and public safety . In practice, in the energy sector including energy production, transmission and distribution, and production, many these sensors are used. In the energy sector, sensors are used to create savings in both cost and energy. Sensors enable smart energy management system and provide real-time energy optimization and facilitate new approaches for energy load management

Temperature sensors are used to detect the fluctuations in heating and cooling a system . Temperature is an important and common environmental parameter. In the energy sector, the basic principle of power generation is the process of changing mechanical energy into electrical energy, whereas mechanical energy is achieved from heat energy, e.g., thermal power plants, wind, water flow, and solar power plants.

B.ACTUATORS

Actuators are devices that transform a certain form of energy into motion. They take electrical input from the automation systems, transform the input into action, and act on the devices and machines within the IoT systems . Actuators produce different motion patterns such as linear, oscillatory, or rotating motions. Based on the energy sources, actuators categorized as the following types

Thermal actuators use a heat source for generating the physical action. Thermal actuators convert thermal energy into kinetic energy, or motion. Generally, thermostatic actuators are composed of a temperature-sensing material sealed by a diaphragm which pushes against a plug for moving a piston. The temperature-sensing material can be any type of liquid, gas, wax-like substance, or any material that changes volume based on temperature.

C.COMMUNICATION TECHNOLOGIES

Wireless communication systems play the major role in activating IoT. Wireless systems connect the sensor devices to IoT gateways and perform end-to-end data communications between these elements of IoT. Wireless systems are developed based on different wireless standards and the use of each one depends on the requirement of the application such as communication range, bandwidth, and power consumption requirements. For example, often renewable sources of energy, including wind and solar power plants are mostly located in very remote areas. Therefore, ensuring a reliable IoT communications in remote places is challenging. Employing IoT systems on these sites requires selection of suitable communication technology

that can guarantee a continues connection link and support real-time data transfer in an energy efficient manner.

Satellite is another communication technology that has a very wide-area coverage and can support low data rate applications in machine-to-machine (M2M) fashion . Satellite technology is suitable for supporting IoT devices and machines in remote places. The study in presents an IoT-based machine-to-machine satellite communication that is applicable to the smart grid, particularly for the transmission and distribution (T&D) sector. A similar study highlights the importance of using satellite-based IoT communications in energy domain such as solar and wind power plants .

The short range wireless technologies, e.g., Wireless Fidelity (Wi-Fi) (https://www.wi-fi.org/) for IoT applications in the energy sector has been widely studies. In the energy sector, the obvious cases of using Wi-Fi include energy metering and building energy management .

V.SECURITY, PRIVACY, AND TRUST IN IOT

The risk on data security and privacy exponentially increases with an unprecedented growth in the deployment of the smart IoT objects. One of the distinct challenges in the IoT infrastructures is the limited computation power and minimal resources of most of the IoT devices . These limited resources preclude the state-of-the-art cryptographic techniques that are indispensable for securing IoT devices, thereby making them vulnerable to a diverse range of security attacks , such as the denial of service attacks and privacy attacks such as data exfiltration or leakage attacks

Considerable efforts and collaborations from governmental and non-governmental entities are required to create IoT interoperability standards and backward compatibility. These standards should also be integrated with privacy controls to guarantee the preservation of users' privacy.

Evaluating trust becomes indispensable in the case of a highly dynamic and distributed network since pervasive infrastructure cannot be guaranteed at all the times in such scenarios which is imperative for public-key based cryptographic techniques. Nevertheless, computing trust has its own inherent challenges, i.e., selection of dynamic trust attributes in accordance with a given application's context, assigning of optimal weights to such attributes for trust aggregation purposes, opting between the event-driven, time-driven, or hybrid approaches for trust updates, and selecting an appropriate trustworthiness threshold for segregating between malicious and non-malicious nodes.

VI.BLOCKCHAIN AND IOT

Current IoT systems mostly rely on centralized cloud systems . In most IoT applications, thousands of IoT devices and machines need to be connected, which is hard to synchronize. Moreover, due to the centralized and server-client nature of IoT when server is vulnerable, all the connected objects are easy to be hacked and compromised, which result in security concerns for the system and privacy issues for users. Fortunately, Blockchain can be a solution for this challenge . Blockchain provides a decentralized and democratized

platform with no need for third party's intervention. The consensus platform of blockchain requires every IoT node proves that it pursues the same goal as others. Verified transactions is also stored in the form of a block, which is linked to the previous one in a way information can never be erased. Moreover, the history of every single transaction at every node can be recorded and is accessible by everyone. Therefore, any member in blockchain becomes aware of any changes in each block immediately.

VII.GREEN IOT

The energy consumption of IoT devices is an important challenge, especially in large-scale deployment of these technologies in near future. To run billions of devices that will be connected to the Internet significant amount of energy is required. The big number of IoT devices will also produce a great deal of electronic waste . To tackle these challenges, a low-carbon and efficient communication networks are needed. Fortunately, these necessities has led to the appearance of the green IoT (G-IoT). The key component of G-IoT is its energy-efficient characteristics throughout the life cycle, i.e., design, production, deployment, and ultimately disposal.

VIII.STANDARDIZATION IN 5G-IoT

The standardization process in the 5G-IoT involves mainly two types of standards. One is the technology standards that deal with network technology, protocols, and wireless communication and data aggregation standards. Second is a regulatory standard that comprises of security and privacy of data.

ARTIFICIAL INTELLIGENCE DRIVEN USE CASES FOR 5G-IoT NETWORKS

The higher data-rates possible in 5G-IoT makes it possible for the implementation of data-hungry and computation intensive Artificial Intelligence (AI) algorithms for various user applications.

Some current and futuristic AI based applications that could be supported over 5G-IoT are summarized below:

1.BIG DATA PROCESSING ENHANCEMENT

. The amalgamation of AI algorithms and 5G tech, the objective of the 5G Intelligent IoT is to process huge amount of data intelligently, optimizing the communication channels and upgrading the utilization of channels effectively [98]. Moreover, the inclusion of AI in the main components of firmware will give safe environment running applications which in return will help in making intelligent decisions completely uninterrupted .

2.THE HORIZON OF HEALTHCARE

The combination of 5G and AI in the field of healthcare can improve the lives of millions of people by upgrading the existing system. Chen et al. [99] designed a personalized emotion-aware healthcare system using 5G that emphasizes on the emotional care, especially for children, and mentally ill and elderly people.

3.SMART TRANSPORTATION SYSTEMS

Vehicles with continuous connectivity, are becoming a reality with the integration of 5G with IoT. This integration has given the ability to access the internet in a more efficient way. Now, car manufacturers have developed their interest and are exploring different markets to bring this technology in the field of transportation systems. Researches have been performed regarding a self-driven vehicle with the use of connecting to the internet.

IX.CONCLUSION

The Internet of Things (IoT) has been an extremely active area of research and development for more than two decades. Although a wealth of exciting activities including standardization, commercial developments and research have been conducted, many challenges still remain open due to the large scale and diversity of IoT devices, the openness of the IoT environment, and the security and privacy concerns**.**Modern technologies such as IoT can help the energy sector transform from a central, hierarchical supply chain to a decentralized, smart, and optimized system. The convergence of IoT and Conversational AI is regarded as successful as we have seen many applications already making their way to people's customized smart spaces such as smart offices, smart homes, and smart vehicles.

In this paper, IOT standards and usecases are reviewed with current trends and applications.

REFERENCES

[1] L. Roselli, N. B. Carvalho, F. Alimenti, P. Mezzanotte, G. Orecchini, M. Virili, C. Mariotti, R. Goncalves, and P. Pinho, ''Smart surfaces: Large area electronics systems for Internet of Things enabled by energy harvesting,'' Proc. IEEE, vol. 102, no. 11, pp. 1723–1746, Nov. 2014.

[2] A. Costanzo and D. Masotti, ''Energizing 5G: Near- and far-field wireless energy and data trantransfer as an enabling technology for the 5G IoT,'' IEEE Microw., vol. 18, no. 3, pp. 125–136, May 2017

[3] N. Kushalnagar, G. Montenegro, and C. Schumacher, IPv6 Over Low-Power Wireless Personal Area Networks (6LoWPANs): Overview, Assumptions, Problem Statement, and Goals, document RFC 4919, RFC Editor, Aug. 2007.

[4]. N. Kaur and S. K. Sood, ‘‘An energy-efficient architecture for the Internet of Things (IoT),’’ IEEE Syst. J., vol. 11, no. 2, pp. 796–805, Jun. 2017.

[5] Ö. U. Akgül and B. Canberk, ‘‘Self-organized things (SoT): An energy efficient next generation network management,’’ Comput. Commun., vol. 74, pp. 52–62, Jan. 2016.

[6].] S. Li, L. Da Xu, and S. Zhao, ‘‘5G Internet of Things: A survey,’’ J. Ind. Inf. Integr., vol. 10, pp. 1–9, Jun. 2018.

[7].] J. Lloret, J. Tomas, A. Canovas, and L. Parra, ‘‘An integrated IoT architecture for smart metering,’’ IEEE Commun. Mag., vol. 54, no. 12, pp. 50–57, Dec. 2016.

[8]. Da Xu, L.; He, W.; Li, S. Internet of Things in Industries: A Survey. IEEE Trans. Ind. Inform. 2014, 10, 2233–2243

[9]. Stojkoska, B.L.R.; Trivodaliev, K.V. A review of Internet of Things for smart home: Challenges and solutions. J. Clean. Prod. 2017, 140, 1454–1464.

[10]. Khatua, P.K.; Ramachandaramurthy, V.K.; Kasinathan, P.; Yong, J.Y.; Pasupuleti, J.; Rajagopalan, A. Application and Assessment of Internet of Things toward the Sustainability of Energy Systems: Challenges and Issues. Sustain. Cities Soc. 2019, 101957. [CrossRef].

[11]. Zouinkhi, A.; Ayadi, H.; Val, T.; Boussaid, B.; Abdelkrim, M.N. Auto-management of energy in IoT networks. Int. J. Commun. Syst. 2019, 33, e4168. [CrossRef].

[12]. Kelly, S.D.T.; Suryadevara, N.K.; Mukhopadhyay, S.C. Towards the Implementation of IoT for Environmental Condition Monitoring in Homes. IEEE Sens. J. 2013, 13, 3846–3853. [CrossRef]

[13]. Kabalci, Y.; Kabalci, E.; Padmanaban, S.; Holm-Nielsen, J.B.; Blaabjerg, F. Internet of Things applications as energy internet in Smart Grids and Smart Environments. Electronics 2019, 8, 972. [CrossRef].

[14]. Collotta, M.; Pau, G. A Novel Energy Management Approach for Smart Homes Using Bluetooth Low Energy. IEEE J. Sel. Areas Commun. 2015, 33, 2988–2996. [CrossRef]

[15]. Nair, V.; Litjens, R.; Zhang, H. Optimisation of NB-IoT deployment for smart energy distribution networks. Eurasip J. Wirel. Commun. Netw. 2019, 2019, 186. [CrossRef].

[16]. AECC, “Driving Data to the Edge: The Challenge of Data Traffic Distribution,” Technical Solution Working Group (WG2) - Automotive Edge Computing Consortium (AECC), Tech. Rep., 2020.

[17]. A. S. Lago, J. P. Dias, and H. S. Ferreira, "Conversational Interface for Managing Non-trivial Internet-of-Things Systems," in Proc. of 20th International Conference of Computational Science (ICCS 2020), vol. 12141, Amsterdam, The Netherlands, 2020, pp. 384–397.

[18]. S. Reddy, D. Chen, and C. D. Manning, "COQA: A Conversational Question Answering Challenge," Transactions of the Association for Computational Linguistics, vol. 7, pp. 249–266, 2019.

[19]. G. Ruggeri and O. Briante, "A Framework for IoT and E-health Systems Integration based on the Social Internet of Things Paradigm," in Proc. of the International Symposium on Wireless Communication Systems (ISWCS 2017), Bologna, Italy, 2017, pp. 426–431.