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A Step towards Green Internet of Things in IT Sector for Sustainable Future

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Abstract:
Nowadays, IOT is the most booming and emerging technology in IT sector. Smart devices embedded with Sensors, RFID, software, network connectivity and necessary electronics that enables them to collect and exchange data over network without requiring human interaction. Such smart devices collect, store and transmit data to number of connected devices which require large amount of energy and in return these devices emits carbon dioxide and electro smog which is harmful to earth. Taking into consideration of global warming and environment hazards, we should step towards Green IOT instead of IOT .Green IOT is cost efficient, energy saving and eco-friendly which fulfils aim of sustainable development. This paper briefs concept, architecture, applications and importance of Green IOT. Also the paper describes comparative study of IOT and Green IOT.

Keywords: *IT(Information Technology) Internet of Things (IoT),Green IoT(GIoT), Smart.*

I INTRODUCTION

A.Introduction to IoT

The "Internet of Things" (IoT) concept was first coined by Kevin Ashton, where smart objects are connected with the Internet. Nowadays, IoT is receiving attention in many fields such as transport, agriculture, industry, and healthcare [1, 2].Following are two definitions given by ITU-T (International Telecommunication Union (ITU) Telecommunication Standardization Sector) and IERC (IoT European Research Cluster), respectively. Definition of IoT by ITU-T "In a broad perspective, the IoT can be perceived as a vision with technological and societal implications. From the perspective of technical standardization, IoT can be viewed as a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on, existing and evolving, interoperable information and communication technologies. Through the exploitation of identification, data capture, processing and communication capabilities, the IoT makes full use of things to offer services to all kinds of applications, while maintaining the required privacy." Definition of IERC: "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."[2,3,4,5] Cisco reports that 50 billion devices and objects will be connected to the Internet by 2020. Also, the Internet of Things (IoT) will contribute $/117 billion to the IoT-based healthcare industry and $1.9 trillion to the global economy according to Gartner and Forbes. Nowadays there is no field or sector which is lagging behind in use of IoT devices. IoT is simple network of inter connected devices which are embedded with sensors ,software ,network connectivity and necessary electronics that enables them to collect and exchange data over network without requiring human interaction. We have IoT based smart phone, smart home, smart watch, smart building, smart hospitals ,smart city, smart grid, smart farming and smart weather monitoring system.

B. IoT Applications

1.Smart home

Smart home facilitates with smart electronic switching system which is getting on presence of person and getting off on absence of person. Then smart lock system which have authenticate user only can unlock . Smart fridge with LCD screen showing what's inside, which food is about to expire and what things need to buy all are available on your smart phone.

Smart washing machine allow to operate automatic remotely. Smart AC can automatically adjust its coolness as per weather.

2. Smart power house

Monitoring and analysing the flow of energy from power house and two way communication with consumers smart meter for analyse `consumption pattern.

3. Power supply controller

Controller for AC-DC power supplies that determines required energy and improve energy efficiency with less energy waste for supply related to computer and electronics devices.

4. Smart Farming

It is solution for tracing, tracking and managing farming activities. Smart farm helps to monitor crops for easy farm management.

5. Smart school

Smart school is very different from traditional school .It has smart board which is more interactive which enhance teaching and learning experience .Smart attendance system which is uses biometric of student and staff members instead of manual attendance. Smart school provide anytime and anywhere learning.

6.Smart city

Smart city having smart traffic control to monitor , manage and control traffic efficiently. It can predict where the traffic could go and take measures to prevent potential congestion. Smart city having smart parking with help of GPS data from driver's smartphone's. It determines parking spots are available or occupied. As well as smart city have smart waste management system to collect waste or garbage according to predefined schedules. Each waste container gets a sensors that gathers the data about the level of the waste in a container. Smart city have IoT based public safety offer real time monitoring , analytics and decision - making tools. CCTV cameras deployed throughout the city with the data from social media and analysing it, also predict crime scenes [6].

7.Smart grid

an IoT-based real-time monitoring system was proposed for power transmission lines to avoid disasters. In the proposed system, conductor galloping, wind deviation, conductor temperature, icing, and tower leaning are visually displayed at the monitoring center. These parameters represent the power transmission lines and operational parameters of the tower. So, the system can implement real-time monitoring and early warnings of disaster for minimizing the damage of smart grid caused by natural disasters[7].

II Challenges of IoT

There are following challenges as stated in [8,9,10]

A Privacy and Security As the IoT become a key element of the Future Internet and the usage of the Internet of Things for large-scale, partially mission-critical systems creates the need to address trust and security functions adequately. New challenges identified for privacy, trust and reliability are:

• providing trust and qualityof-information in shared information models to enable re-use across many applications.

• Providing secure exchange of data between IoT devices and consumers of their information.

• Providing protection mechanisms for vulnerable devices.

B. Cost versus Usability IOT uses technology to connect physical objects to the Internet. For IOT adoption to grow, the cost of components that are needed to support capabilities such as sensing, tracking and control mechanisms need to be relatively inexpensive in the coming years.

C. Interoperability In the traditional Internet, interoperability is the most basic core value; the first requirement of Internet connectivity is that "connected" systems be able to "talk the same language" of protocols and encodings. Different industries today use different standards to support their applications. With numerous sources of data and heterogeneous devices, the use of standard interfaces between these diverse entities becomes important. This is especially so for applications that supports cross organizational and various system boundaries. Thus the IOT systems need to handle high degree of interoperability.

D. Data Management Data management is a crucial aspect in the Internet of Things. When considering a world of objects interconnected and constantly exchanging all types of information, the volume of the generated data and the processes involved in the handling of those data become critical.

E. Device Level Energy Issues One of the essential challenges in IoT is how to interconnect "things" in an interoperable way while taking into account the energy constraints, knowing that the communication is the most energy consuming task on device.

III Introduction of Green IoT

To overcome the issue of consumption of large amount of energy and emission of carbon footprints by the IoT based devices , there is more appropriate , cost and energy efficient solution i.e. Green IoT. The concept of Green IoT make the use of IoT based devices in environment friendly manner. The enabling technologies for green IoT are called information and communication technologies (ICTs) [11]. ICTs can cause climate change in the world [12, 13, 14, 15,16] because with the growing application of ICT much more energy has been consumed. The consideration for sustainability of ICTs has concentrated on data centers optimization through techniques of sharing infrastructure, which leads to increasing the energy efficiency, reducing CO2 emissions and e-waste of material disposals [16]. The greening ICT process includes the economically and environmentally responsible ways of design, fabrication, and use of ICT devices and infrastructures [17]. Therefore, to satisfy general principles of G-IoT, it is necessary to [18]:

 Reduce energy consumption of facilities with appropriate hardware design or with the assistance of software;

 Transmit information only when is needed/required using the minimized data path length and applying advanced communication techniques;

 Design G-IoT components in an eco-friendly manner;

 Use renewable green power sources (e.g., usage of solar, wind, water).

Therefore, green IoT is indeed focusing on green manufacturing, green utilization, green design, and green disposal [18]. These issues are described as follows.

1. Green use: minimizing power consumption of computers and other information systems as well as using them in an environmentally sound manner.
2. Green design: designing energy efficient for green IoT sound components, computers, and servers, and cooling equipment.

3. Green disposal: refurbishing and reusing old computers and recycling unwanted computers and other electronic equipment.

Green manufacturing: producing electronic components and computers and other associated subsystems with minimal or no impact on the environment.

Greening ICT is enabling technologies for green IoT, which includes green wireless sensor networks (GWSNs), green machine-to-machine communication (GM2M), green RFID, green data center (GDC) [18], green cloud computing (GCC), green Internet, and green communication network as shown in 1. Therefore, green ICT technologies play an essential role in green IoT and provide many benefits to the society such as decreasing the energy used for designing, manufacturing, and distributing ICT devices and equipment.

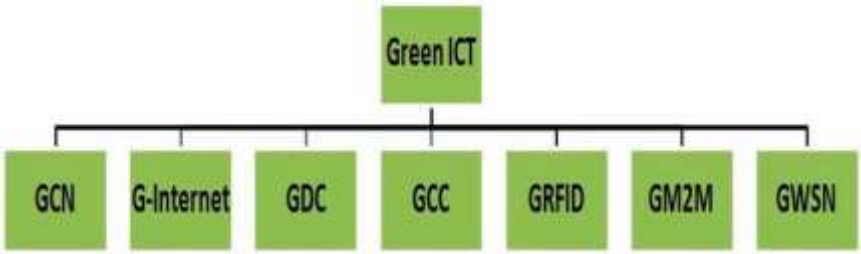

Fig 1. Green ICT technologies.

A. Green DC

Data centers are responsible for storing, managing, processing and to disseminate all types of data as well as applications. Data Centers should be designed which should be based on renewable energy resources. Apart from this, routing protocol should be designed to make them energy aware and turn off idle devices in the network .

B. Green Internet

Technologies Green Internet Technologies requires special hardware and software which are specifically designed to consume less energy without reducing performance while minimizing utilization resources.

C. Green Wireless Sensor Network

WSN has many sensors nodes but with small power and small capacity consists of plenty of sensor nodes with limited power and storage capacity. Green WSN can be achieved by Green Energy Conservation technique, Radio Optimization technique, Green routing techniques technique leading to reduction mobility energy consumption, Smart Data algorithms which will reduce storage capacity requirement as well as data size.

D. Green RFID

RFID tags can store data or information at small level for any objects with which these are linked. RFID transmission requires a few meter range of RFID systems. One type of RFID tag i.e. Active tags have built–in batteries for continuous transmitting their own signal while another type i.e. Passive tags don't have an active battery source. They store energy from the reader. Reducing the size of an RFID tag can help in reducing the amount of non-degradable material.

E. Green Cloud Computing

As we already know that in cloud computing, we have services like IaaS, PaaS and SaaS. In green scheme, hardware and softwares are to be used in such a way to reduce energy consumption. Policies has to be applied which is energy efficient. Also Green cloud computing scheme based technologies are to be used like communication, networking etc.

F. Green M2M

Since a large no of machines are involved in M2M communication, so there should be energy saving based transmission power and optimized communication protocols, and routing

algorithms should also be there. There should be check passive nodes so that energy can be saved[19].

Green IoT highlights on the smart operation of devices with a decrease in energy waste. Appropriate Ventilation of Heat Generated from Servers and Data Centers, Conserve Energy using Smart IoT Technology are various strategies to conserve a lot of energy by implementing Green IoT.

IV. Application of Green IoT

Applications of IoT and G-IoT are identical. That means IoT and GIoT are not different. Smart city, smart home, smart grid , smart health care, smart school and campus and smart car etc. are some examples of green IoT based applications.

V. Conclusion

This paper has been discussed the concept of Internet of Things. As well applications of IoT discussed .It reviewed the challenges of IoT. The concept of Green IoT and it' component discussed . The examples of Green IoT also reviewed.This paper presented that we can implement IoT based applications in Green IoT using green data center, green internet ,green cloud computing and green RFIDs for efficient energy optimization ,economically efficient and environment friendly which is aim of sustainable development. This paper reveals comparative study of IoT and GIoT in it's concept, application and importance.

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