IoT : A REVIEW ON SECURITY ISSUES AND MEASURES

Rinju Ravindran
MTech Scholar
Dept. Of ECE
Vimal Jyothi Engineering College, Chemperi
rinjuravindran20@gmail.com

Jerrin Yomas
Asst. Professor
Dept. Of ECE
Vimal Jyothi Engineering College, Chemperi
jerrinyomas@vjec.ac.in

Jubin Sebastian E
Asst. Professor
Dept. Of ECE
Vimal Jyothi Engineering College, Chemperi
esjubin@vjec.ac.in

Abstract: **Internet of Things (IoT) is an emerging wireless technology that merges pervasive computing, ubiquitous computing, communication and sensing technologies to establish an anytime-anywhere connectivity between real and digital world. It is providing a lot of advantages to the users. So it is very important to provide security for this technology. Establishment of trusted architecture is very important. In this paper, the possible security issues and the various approaches towards a secured network is studied.**

Keywords- RFID technology, Adaptation layer, 6LoWPAN, CoAP, DTLS

I. INTRODUCTION

Due to the widespread popularity of wireless communication systems, it has provided path for the expanded use of internet. This internet connectivity also leads to the development of Cyber-Physical Systems (CPS) to interlink the physical and cyber world. There are various technologies that come under this CPS namely IoT, advanced robotics, autonomous or near-autonomous vehicles and automation of knowledge work. Out of this, IoT is of highest economic impact. In the case of IoT, each object will be having a unique identity and they are capable of communicating with each other.

Fig.1. Schematic of IoT

Sensory swarm is the collection of smart systems. Cloud will provide all sorts of computation and storage services. Immersed human concept is used to specify the nature of humans. It highlights that people will be completely dependent and immersed in the field of technology. IoT is aimed at transforming traditional city to smart city. The different information are collected by using network of sensors, cameras, speakers, screens, smart meters, etc. Because of the large volume and its heterogeneity in data representation, the collected information is termed as Big-Data. These devices are capable of communicating as well as sharing their information with the help of internet. IoT increases scope of current internet [1]. It provides new design opportunity and at the same time, there are various challenges also. A main challenge is to ensure high interoperability of interconnected devices with high privacy and security. IoT is established with the help of wireless sensor networks (WSN) and internet. Ubiquitous connectivity of devices is achieved mainly with the help of IP-based communication protocols. IoT includes all sorts of machine to machine, machine to man, man to machine or machine to mobile communication. It provides various services which includes control, diagnosis, remote monitoring, intelligent information services for the intended users, etc.

II. BASIC IoT ARCHITECTURE

The general network architecture is divided into three layers: sensing layer, transport layer and application layer as shown in Fig.2.[2].

Sensing layer is also called as perception layer. This layer is responsible for collecting the information and gathering the physical parameters. Data acquisition and collaboration is the

main feature of the perception layer. It has various sensors namely temperature and humidity sensors, GPS, RFID label, camera, etc. This layer consist of mainly two sections: field devices which possess sensing, computing and communication capabilities and field networks obtained by the interconnection of these devices. This layer aims at sensors with low power consumption and high performance. RFID technology and sensor network technologies are the key technologies employed in this layer.

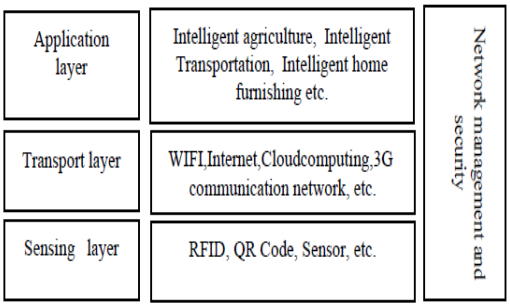

Fig.2. IoT Network architecture

Transport layer concentrates on a variety of networks. It consists of the internet, 3G communication networks and the cloud computing platform. It is considered as the center of the whole network. The interface between users and IoT is achieved using the application layer. It is the upper layer in the IoT architecture which is capable of providing services to different sections or firms such as automobile, healthcare, education, logistics, agriculture, insurance, media, environmental monitoring etc. This layer makes use of data mining, cloud computing, fuzzy recognition and other intelligent computing technologies to process magnanimous data and provide effective information.

III. PROTOCOLS IN IoT

Institute of Electrical and Electronics Engineers (IEEE), Internet Engineering Task Force (IETF) and internet society are the principal technical development and standards setting bodies of internet. Fig.3. illustrates the protocol stack designed by them [3]. IEEE 802.15.4.supports low energy communications at physical (PHY) and medium access control (MAC) layer. It is the base for IoT communication protocols for the above layers. It supports a data rate of 250 kbps and the range of distance is about 10 meters.

Layer	**Protocol**
Application	CoAP
Network/Routing	IPv6, RPL
Adaptation	6LoWPAN
MAC and PHY	IEEE802.15.4

Fig.3. IoT protocols

IEEE 802.15.4e addendum supports time synchronized multi hop communication at MAC layer. IEEE 802.15.4 uses atmost 102 bytes for data transmission. IPv6 is having more address space than IEEE 802.15.4. So the IPv6 packets are made to transmit over IEEE 802.15.4. This led to the development of IPv6 over Low Power Wireless Personal Area Networks (6LoWPAN). It helps in packet fragmentation and reassembly. Routing Protocol for Low power and Lossy Networks (RPL) are used for routing over 6LoWPAN. Communications at application layer is supported by a protocol called as Constrained Application Protocol. It concentrates on the interoperability of devices. The workgroup in IEFT that is designing the CoAP protocol is called as the Constrained RESTful Environments (CoRE). It is a network oriented protocol which supports low overhead, multicast, etc. It has been designed in such a way that it overcomes the problems of HTTP such as high computation complexity, low data rate and high energy consumption. It is a light weight protocol which is used with constrained nodes and constrained networks.

IV. SECURITY ISSUES AND MEASURES

The security requirements of IoT mainly focus on the confidentiality, integrity, authentication, non-repudiation, availability, resilience, privacy,

anonymity, liability and trust. Availability and resilience are to be given importance if the network is prone to internet originated attacks like Denial Of Service (DOS). Direct sequence spread spectrum (DSSS), direct sequence Ultra-Wideband and Chirp spread spectrum (CCS) modulation methods are used to achieve reliability in the PHY layer. IEEE 802.15.4 security is achieved at the MAC layer with the help of efficient symmetric cryptography. In-order to encrypt data, symmetric block ciphers is used in both hardware and software. Encryption and decryption techniques help in achieving confidentiality. Data integrity is achieved through message integrity codes (MIC). Availability is ensured by using Intrusion Detection System (IDS) and firewalls. Integrity-protected timestamps, sequence numbers, nonces, etc. are used for replay protection.

In [2], the author described the security issues by considering the different layers of IoT. In perception (sensing) layer, the RFID and wireless sensor network security threats are the major problem makers. The RFID security threats mainly includes copying an identical RFID label (replication attack), leakage of location information of RFID tags and users, channel blocking attack in which attacker occupies the channel long time, forgery attack, impersonation attack in which attacker fake as a legitimate reader and tampering attack where the information is modified after listening to it and then sends to the other node. Fake node and malicious data, DOS, timing attack and side channel attack are other security threats [6]. External attack and link layer security, Witch attack, HELLO flooding attack, wormhole and sewage pool, Selective forwarding attack, broadcast authentication and flooding etc are some of the possible attacks in the wireless sensor networks. In network layer [6], traditional Security Problems like illegal access networks, eavesdropping information, confidentiality damage, integrity damage, DoS attack, Man-in-the middle attack, virus invasion, exploit attacks, etc. may occur. Security, interoperability, and coordination of network are affected as a result of heterogeneity of the networks. This leads to compatibility problem which forms another security threat to network layer. Privacy disclosure is another problem in this layer. DOS attack, DDOS attack, impersonation attack, middleman attacks, cross heterogeneous network attacks etc. are the common issues in the transport layer. When considering the application layer [4], the major issues occurs while selecting the same database content according to the different access, providing user privacy information protection, solving the leakage of information tracking problem, taking the computer forensics, destroying the computer data, protecting electronic products and software intellectual property etc.

In [4], the author concentrates on the various security policies. Physical methods or code mechanisms or a combination of both the methods are used for providing the RFID security. Data encryption, blocker tag, tag frequency modification, jamming, kill order policy, etc. are the commonly used physical methods whereas the code mechanisms include the design of protocols for RFID node security. Hash Lock protocol, LCAP, Hash Chain and re-encryption protocol are the RFID security protocols. Methods like key distribution policies, intrusion detection mechanisms, security routing protocols, etc are also employed to achieve the security. Specific authentication cohesive mechanism, the end-to-end authentication and key agreement mechanism, PKI (Public Key Infrastructure), WPKI for wireless, Security routing, Intrusion detection, etc. are used to tackle the security problems in the network layer [6]. It also describes about the security measures in application layer. Symmetric key cryptosystem, public key crypto-system and certification transfer technology are used to achieve authentication and key agreement in the heterogeneous network. Fingerprint technology, digital watermarking, anonymous authentication, threshold cryptography, etc. are employed to attain the security of private information.

The necessary security services in IoT are confidentiality, data integrity, source integrity or authentication, availability and replay protection. Encryption/decryption techniques help in achieving confidentiality. Data integrity is achieved through message integrity codes (MIC). Availability is ensured by using IDS and firewalls. Integrity-protected timestamps, sequence numbers, nonces, etc. are used for replay protection. Datagram transport layer security (DTLS) and IPSec are the security protocols used to attain security in the transport layer and network layer respectively. Malicious activities in the network can be detected using IDS and

unauthorized access can be blocked by the use of firewalls. We have to provide security to communication, networks and data in the IoT.

V. CONCLUSION

The network architecture and protocols of IoT are discussed in this paper. The security threats in different layers are studied. The issues are different in different layers. In-order to achieve security, different measures like encryption and decryption, key mechanisms, security protocols, end to end authentication, etc. are performed. A study on the existing research works has been done.

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