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Letter

Security Review in Internet of Things

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Abstract: In this decade, the exceedingly rising state of the art industry is internet of things where trillion devices will be connected. IoT is being appraised to transform the concept of communication. To support this paradigm shift, companies and organizations are endowing worthwhile attention with researchers and scholars. Internet of thing is lending a hand with its essential role to build a new and smart world in a smarter way where everything will be under the umbrella of it. The internet of things enables an overwhelming smartness to help the humankind with various entities and diverse applications. Although, it is greatest achievement in this decade but some prevails are being engendered calamitous situations with subject to security concerns such as threats, vulnerabilities, attacks in internet of things with its connected and inter-connected devices and objects. Some hazards are critically perilous and alarming to internet of things such as physical attacks, network attack, encryption attacks, software attacks, authorization, surveillance, identity theft, vandalism, secure communication and so on. The most salient concern and important part on internet of things is secure architecture of internet of things. In near future with the connectivity of billion or trillion devices, it would be very difficult to resolve the security issues for impending generations. In this paper, we reviewed different security architecture of IoT and highlighted the absence of security layer in all models.

Keywords: Internet of Things, Architecture, Security

1. Introduction

The internet of things emerging industry paradigm clasps the pledge to remodel the communication concept with its estimated worth of trillion dollars, with the connectivity of billion devices and objects through its substantial virtual and physical infrastructure by which IoT is proclaiming to transfigure concept of communication such as smartphones, smart grids, video connectivity, video conferencing, GPS connectivity, vehicular connectivity, health devices and so on. In broad spectrum, transmitting and receiving data is tranquil in this era. According to Ericson internet of things has the connectivity of 5.7 million devices every day. In near future connectivity of IoT will be billion devices. So, the triumph and on growing curve of IoTs with bright future lean on its security. To support this revolution or paradigm shift, a layered architecture is required like OSI model to deal with its vulnerabilities. This contribution will pave the way to acquire a better security solution. We divided our contribution in sections: in Section II we described previous work in IoT's and in section III we delineated absence and importance of security layer in internet of things architecture. In section IV we discussed; conclusion and future discussion

2. Previous Work

The state of art emerging industry in this decade with its extra-ordinary growth and the impact on the people life with regime or paradigms shift industry is considered internet of things industry. Where, it is reshaping the modus operandi of people life and paths of communication, there, it is also gaining the credibility of changing the business concept. It is extremely entrancing fact that the emerging industry in this

decade is internet of things, from its start to up to 2019 every paper and every researcher who is paying great attention to internet of things has taken into account its layered architecture. In this section we analyzed the fact which is mentioned. So, we defined absence of security layer in architecture for IoT which might be imperative for upcoming generations. If we categorize the presented architecture proposed by different scholars [1-107] they proposed three layers, four layers, five layers and even some illustrated six layers but none of them added security layer as a separate layer as it is essentially required or needed. In every communication device through its virtual of substantial infrastructure either software/hardware even if we download or upload or install applications through network or sharing are with built in bugs and even, they collect or gather personal information and have access to device data. So, with the help of these paper and literature review, we come to this point that security layer is the most important layer in the architecture of internet of things which is missing from the architecture of internet of things.

3. Absence of Security Layer

Fact can be observed that there are different types of layers in IoT architecture [1-107] such as perception, things. middle wear. 6lowpan, data-link, internet, adaptation, transport, sensing, decision, support, action, link session, transmission, router, hub, cloud messaging, objected oriented, SOA layers and so on but these models do not define the security layer as an independent layer for internet of things. In the papers from [1-107], they stated different layers architectures and they disclosed different types of threats in IoT and also described their prospective solutions in that papers. But with the passage of time, as the internet of thing industry is going to be matured, threats are rapidly increasing day by day. In next decade, every device will be connected to internet. And IoT will gain credit of modernization to remodel the concept of communication. Due to these reasons, internet of things is transforming from internet of things to internet of everything. Where, the internet of things is enabling an overwhelming smartness to help the humankind with various entities and diverse applications there, threats are increasing besides these facts. Although, it is a magnificent procurement in this decade, regardless of all accomplishments, yet, some persuade are being provoked for devastating situations and conditions with subject to security concerns such as threats, vulnerabilities, attacks in internet of things with its connected and inter-connected devices and objects. Some pitfalls are critically periling and alarming to internet of things such as physical attacks, network attack, encryption attacks, software attacks, authorization, surveillance, identity theft, vandalism, secure communication and so on. The most pivotal concern and important part of internet of things is secure architecture. There are usually two types of hacker which gain access to system or network are considered as active attackers and passive attackers. Active attacks are frequently blatant and aggressive in which victims promptly become aware because of transmutation behavior of system, when they transpire. These are immensely malicious in nature, such as destroying memory or files, locking out users, or forcefully gaining access to a targeted network or system. Usually, hackers which avail oneself of active attacks are not much concerned with their activities being detected because by the time the attack is detected the damage is already over and done or is underway. Passive attacks frequently retain non-disruptive and conventional methods so that the hacker does not draw attention to the attack. The major aim of the passive attack is to attain access to user/system or network and to gather all data without detection. Many security breaches and data hacking are usually targeted data collections including the exposure of debit card and credit card payment information as well as personal data of user identifying information and legitimate access to confidential data

The attacker/ hacker takes unauthorized access to data, purloins the system data, rejigs the system, information (See Figure 1). Because of these facts, security infrastructures are becoming arduous issues for standardization. To overcome these challenges campiness, organizations and countries are paying fruitful attention such as Hydra, Runes, IoT-A, E Japan strategy, I-Core, Sensei, IoT-6, IoTivity, AllJoyn's. Fp7, horizon2020, one M2M platform, 4ward&sail, Fire++, Find, FIA, GENI and so on. Proliferation devices connectivity increase data collection of users which is not plain sailing to handle such as smart phones, tablets, laptop which brings with personal information like credit card, debit card, bank accounts, passwords, email account, business history, office information, contacts, controlled vehicle information and various others which are vulnerable to user and easily accessible, hacked and theft by hacker

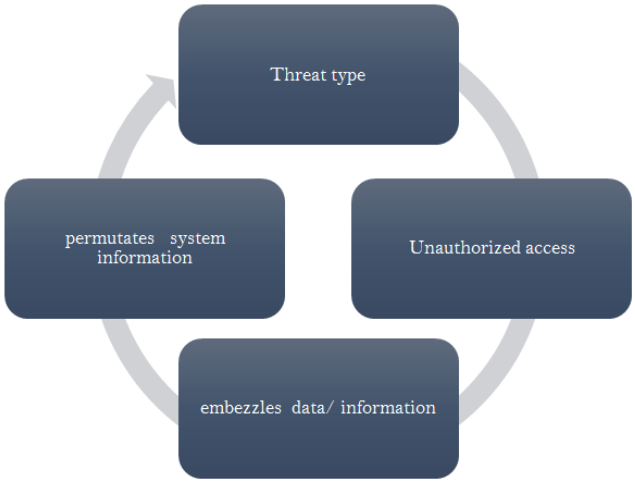


Figure 1. *Security breaches in IoTs.*

In past surveys almost more than 80 percent organizations have been affected with threats Either internal threats or external threats. Threats usually occurs due to lack of web interface, authentications, insecure networks, transport encryption, cloud interface, mobile interface, security configurations firmware security, physical security and so on. If we categorize the internal and external threats, internal

threats up to 60 percent while remaining threats are external Threats can be classified in two important branches, so it can be discussed as internal attacks and external attacks. Which are shown in Figure 2.

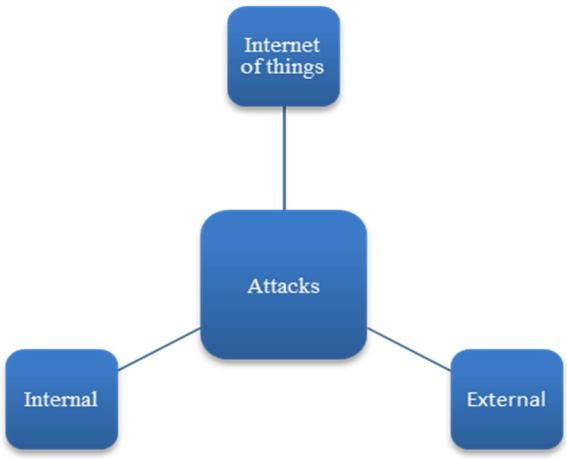
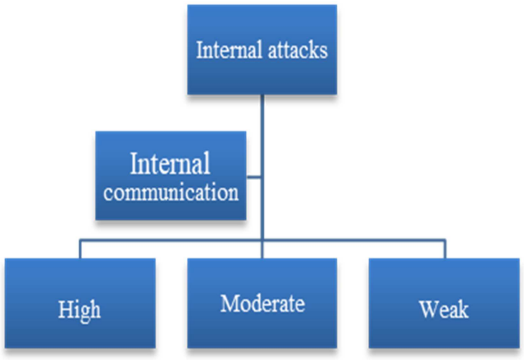
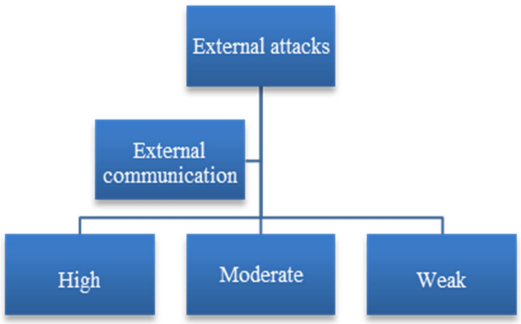


Figure 2. *Internet of things attacks classifications.*

Internal attacks explain the security of internal communications and data whereas, the external attacks define the external communication Furthermore, these attacks have further three more classifications. Weak Moderate and high which are described in Figure 3(a) and Figure 3(b). (See Figure 3 (a and b)



(a) description of internal attacks



(b) description of external attacks

Figure 3. *Description of internal attacks and external attacks.*

Weak threats usually attack to unclassified data, weak passwords, and less sensitive information with monitoring the system vulnerabilities. So, such types are happening on daily basis.

Moderate threats usually come about on classified data due to dearth of monitoring control because systems transfer considerable amount of sensitive data / information through network or over network with common user interface. These types of activities usually occur once in a weak or in or month.

High Threats commonly transpire on confidential and classified data/information with access upon private/ regulated data due to lack of security control on transmission. These types of attacks usually crop up on isolate systems once in a year or in 5 years. These types of attacks ratio are very less.

These types of attacks can be divided in to four major classes which can be described as physical, software, encryption and network. Physical attack executed nearby or short distance of device. Network attack is perpetrated on network layer to gambit on network for manipulation or damage of internet of things network and as well as hacking of passwords, data and larceny of information. Software attacks ensues when system when system contains vulnerabilities and proffers chance to hacker to enter system to harm. Encryption attacks usually transpire for breaking encryption [19]. Sensor attack happens on node/ gateways. These four attacks are major type of attacks which have their sub- classes to destroy the IoT network. Some important attacks are defined in table 1 (see Table 1) which have capability to lead the catastrophic conditions to the network (see Table 1).

Table 1. *Common Attacks in IoT [21, 29] - [32, 66-108] in internet of thing.*

Physical	Network	Software	Encryption
Sensor	Fake node	Side channel	Fragmented
Replication	Forged	Channel blocking	Impersonation
Tempering	Selfish	Wormholes	Selective forward
Timing	Node Capture	Sync	Software Bugs
Malicious	Routing	Dos	DDos
Cross heterogeneous Network	MAN, in Middle	Synbil	Sinkhole
Sleep deprivation	Spoofing	Eavesdropping	Insert
Privacy	Replay	Capture	Atmosphere
Power loss	Power disclosure	Noisy data	Node Tempering

As well as security concern is important, privacy part must also be included in that layer. There are three important privacy issues in IoTs which can be described as Trust management. Data protection and Vulnerabilities (see Figure 4) [110]. Privacy of the consumer and customers are very important because IoT is estimating with trillions of dollars industry in upcoming future with billions of the customer where more than half world will be dependent of IoTs or IoEs. In wireless communications it is absolutely provoking to list of challenges such as big data, data processing, data

management, efficient battery management system, communication infrastructure, technology infrastructure, immaturity, standards, procuring, privacy breaches and last but not least security risks. So, privacy and security challenges of internet of things are most important [111]. Some parameter must be defined such as integrity, confidentiality, authentication, data management and interoperability to attain secure and reliable communication. [73-78]

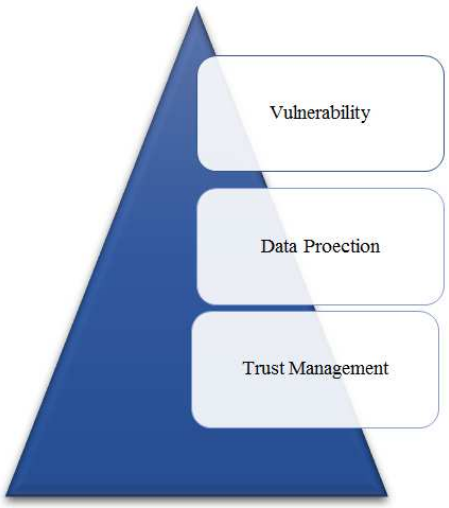


Figure 4. *Major privacy issues in IoTs.*

In Internet of things Network, Software and Encryptions attacks are most common attack are now a days. due to absence of the security layer, the attackers gain more chance to hack the data (the ratio of these have been described in Figure 5, (see Figure 5) So. with concerned of internet of things, there should be a standard model or a frame of reference model to protect the data and liabilities including with the security layer in IoTs because sooner or later it will be the part of internet of things With the maturity of internet of thing the attacks will perfoliate to the roof. So, a frame of reference model is essentially required with the addition of security layer.

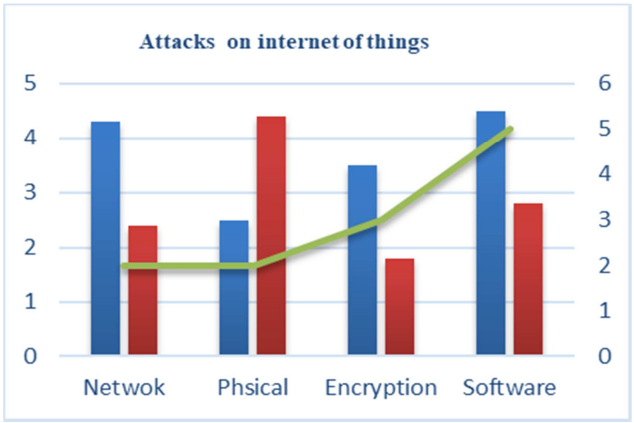


Figure 5. *Ratio of attacks in IoTs.*

It is true fact that great opportunities always come with great responsibilities such as internet of things are engendering unprecedented security problems such as Data security, network security, operating system security, server security, device/physical security, secure devices, authorization and authentication, devices updates managements, data confirmation,, communication security, data privacy, data integrity, high availability, data transmission safety, software updates, network size management, hardware security, lack of specialists, lack of a universal standard and so on.

4. Conclusion and Future Discussion

In this paper, we analyzed pervious published work by researchers, scholars and scientists where three, four, five and six layers are presented in IoT layered architecture but security layer is not included as independent layer in it. They did great work to secure IoTs but they did not add an independent security layer to make these models more and more secure. Because security layer independently can perform better and achieve great results to provide better security and secure communication Security layer must be including in this architecture as independent layer. In near future, with the maturity of IoTs, there will be massive escalation in connectivity of devices, Number of threats or attacks will be rapidly increased. So, it will be very difficult to manage security issues of IoTs. So, more work is required to make a global standard architecture model for IoTs and also need to pay vital attention to include security layer as independent layers which is the essential part of it.

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