
A Survey of Network and Information Security

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Abstract

Security threats show abnormality in security, safety, privacy, and trust as network security-related data, in short, security-related data. The first step to detect network attacks and intrusions is to collect security-related data. In this paper, we will present a lot of approaches to solving network and Information Security issues. We survey network security in LTE technologies, Vehicular ad-hoc networks, and security in Wireless Sensor Networks. Internet of Things. In this paper, we describe many methods in Information Security that consist of Information Security in Big Data and Cloud Computing.

Keywords

Survey, Network, Information Security

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1. Introduction

Security threats and economic loss caused by network attacks, intrusions, and vulnerabilities have motivated intensive studies on network security. Typically, data collected in a network system can be used to detect security threats. We define these data as network security-related data. Studying and analyzing security-related data can help detect network attacks and intrusions, thus making it possible to measure the security level of the whole network system further. The first step in detecting network attacks and intrusions is to collect security-related data.

Network security consists of the policies and practices adopted to prevent and monitor unauthorized access, misuse, modification, or denial of a computer network and network-accessible resources. Network security involves the authorization of access to data in a network, which is controlled by the network administrator. Users choose or are assigned an ID and password or other authenticating information that allows them access to information and programs within their authority. Network security covers a variety of computer networks, both public and private, that are used in everyday jobs; conducting transactions and communications among businesses, government agencies, and individuals.

Networks can be private, such as within a company, and others that might be open to public access. Network security is involved in organizations, enterprises, and other types of institutions. It does as its title explains: It secures the network, as well as protects and oversees operations being done. The most common and simple way of protecting a

network resource is by assigning it a unique name and a corresponding password.

With the rapid development of network and communication technologies, there has been an increasing amount of attention on the security of network systems [1]. Network security is usually reflected by relevant data generated, originated, or extracted from the network system. By studying the data related to network security events, the security of the network system can be quantified and measured.

Security threats, safety, privacy, and trust as network security-related data, in short, security-related data. The first step to detect network attacks and intrusions is to collect security-related data. Generally, network data can be collected from both the output and input of a system and plays a vital role in IT as it is crucial in managing and troubleshooting network systems, detecting network intrusions, and billing network traffic. Many papers have published techniques in security research areas [74][75][76]

Usually, data anomalies can reflect network attacks and intrusions. Thus, we can detect network attacks by searching for abnormal network data. We refer to this kind of data that can help reflect the security status of a network system as network security-related data, and they may be features, signatures, or fingerprints of a specific attack behavior [2]. For example, Time To Live (TTL) is a type of network security-related data. TTL specifies the maximum number of segments allowed to pass before a router discards an IP packet.

2. Network Security Survey

2.1 Network Security in LTE Technologies

The long-term evolution (LTE)/LTE-advanced (LTE-A) network provides advanced services for billions of users with its higher bandwidths, better spectrum efficiency, and lower latency than legacy cellular networks. However, it still suffers from new security threats due to its IP-based heterogeneous architecture. Therefore, there is a critical need to perform rapid and accurate network security measures in the LTE/LTE-A network. To achieve LTE/LTE-A network security measurement, security-relevant data (in short security data) collection and data analysis for attack detection are required as prerequisites.

In recent years, the jamming detection methods in wireless sensor networks and ad-hoc networks have been widely researched. However, there is little available literature related to detecting LTE/LTE-A jamming attacks, and in most cases, these kinds of attacks are difficult to detect and resolve. Xu et al. [3] discussed the effectiveness of three single measurements as the basis for detecting a jamming attack, including signal strength, carrier sensing time, and Packet Delivery Ratio (PDR). The results showed that no single measurement is sufficient to determine the presence of a jammer under certain circumstances. Both signal strength and carrier sensing time can only detect the constant jammer and deceptive jammer, but they are powerless to detect a random jammer or a reactive jammer.

Fragkiadakis et al. [4] presented anomaly-based intrusion detection algorithms by observing the changes in the SNR statistical characteristics including average SNR, minimum SNR, and max-minus-min SNR. The authors first investigated local algorithms using simple threshold algorithms and Cumulative Sum (CUSUM) algorithms respectively; then they investigated a fusion algorithm using the Dempster-Shafer algorithm to fuse the output of the local algorithms and collaboratively detect jamming attacks.

Lichtman et al. [5] proposed a jamming detection method for LTE/LTE-A, especially on the

PUCCH based on monitoring the excess PUCCH energy and an abnormal amount of PUCCH errors. The power levels on the PUCCH should be by the transmit power commands assigned by e-NodeB, so the detection method uses a simple energy detector on the baseband samples to detect the presence of excess energy or abnormally high amounts of energy in the PUCCH region. The detection method based on the abnormal amount of errors monitors the bit errors in received Channel Quality Indicator values to seek for the sudden increase in errors on the PUCCH and compares to other physical channels like PUSCH to determine if there is a jamming attack.

The LTE/LTE-A signaling attackers always send malicious wake-up packets to trigger the bearer setup procedure, this can lead to the transmission of a large number of control messages among different network elements and saturate the LTE/LTEA network's resources, so most of the signaling attack detection methods are based on the observation of bear inter-setup time or the wake-up packet generation rate [6].

Bassil et al. [7] proposed a detecting method for signaling attacks. The collected data used for detection include UE number, bearer number, and time of activation or deactivation of a particular bearer. The number of bearer requests per UE and the inter-setup time can be obtained from the above dThis. The resulted in obtaining the average lifetime per bearer, and the number of bearer activation requests issued by a specific UE for a specific bearer.

Gupta et al. [8] collected features of uplink wake-up packets, like their frequency, destination IP, destination port, etc. to obtain a set of feature vectors, containing normalized destination IP entropy, normalized destination port entropy, normalized source port entropy, normalized packet length entropy, normalized wake-up rate, variance of inter wakeup times, response-request ratio. Support Vector Machine (SVM) was used to perform supervised learning of standard data. This work needs to calculate a set of vectors the s in data collection proc so that the efficiency may be not good. Privacy and resource consumption were not considered in this work.

Pavloski et al. [9] proposed a simple signaling attack detection mechanism by observing the fact that their low-band usage of communication resources can identify this kind of attack. The data containing the total connected time and the connection but no data transmission time can be collected in each mobile device or a centralized node such as eNodeB for detecting this attack. The proposed method defines a cost function using an Exponential Weighted Moving Average (EWMA) and decides by comparing a real-time cost with an average cost in a period.

Then we will review some detection methods that focus on SIP message attacks and SIP flooding attacks. The following presents detection methods against abnormal SIP messages. Wahl et al. [10] presented a signature-based anomaly detection method in which SIP messages are embedded in a vector space to reflect the characteristics of the SIP traffic. The presented method first extracts feature strings using the definitions of "tokens" and "n-grams", then both global and local anomaly detection methods based on geometric learning models are used to detect unknown attacks. The core of geometric models is to calculate the Euclidean distance in the vector space.

Nassar et al. [11] presented an online monitoring approach based on SVM to detect SIP-related attacks. In the proposal, the SIP traffic is cut into small slices, and 38 features of SIP traffic flows are extracted containing general statistics, Call-ID based statistics, distribution of final state of dialogs, distribution of SIP requests, and distribution of SIP responses. These features are the input of an SVM learning machine. This method performs well for detecting flooding attacks and Spam over Instant Messaging (SPIM)

Given that the malformed SIP messages attacks and the SIP flooding attacks are the most common attacks on IMS, we here list some detection methods that specifically target these two attacks. Seo et al. [12] presented an anomaly detection method based on Stateful Rule Tree. The main idea is refining the rules of the general RFC 3261 rules and creating a rule tree structure. In the detection of malformed SIP messages, they applied a rule-matching algorithm to check if the header of a packet follows the security rules they designed and detect unmatched or undefined message headers. In the detection of the SIP flooding attack, they adopted the state transition models in the 3261.

Zhang et al. [13] presented an automatic detection scheme for SIP flooding attacks and SIP malformed messages attacks on VoLTE. To detect the former attacks, it employs threshold-based algorithms in which the instant amount of SIP packets received from the VoLTE interface within one minute is compared with a threshold. Nevertheless, the determination of the threshold is not specified, and experiments did not evaluate the performance of their detection scheme.

The detection methods for SIP flooding attacks have drawn many researchers' attention. Introduced below are some works concerned with SIP flooding attacks. Lee et al. [14] presented a statistical and learning-based detection method for SIP flooding-based DoS attacks. The presented algorithm compares merely the collected factors of the traffic including IP, URI (Uniform Resource Identifier), Call-ID, and Method (e.g., INVITE, BYE) with their detection rules. Every detection rule has a corresponding threshold value that is updated dynamically.

Zhang et al. [15] presented an SMS spammer detection scheme based on behavior analysis. The scheme integrates multiple behavior attributes of users and extracts statistical properties from SMS records which record the information of each SMS, including calling number, called number, transmission time, receiving time, and message length. Then five machine learning algorithms including Binary Decision Tree, Random Forest, SVM, Logistic Regression, and SelfOrganized Feature Mapping are used to train the classifier of spammer and non-spammer.

The content-based SMS spam detection techniques may touch upon user privacy issues and huge memory requirements on the server side. The latter detection system on the network side can help to reduce the cellular bandwidth consumed by SMS spam and achieve real-time transmission of massive SMS messages. The detection can be based on behavior analysis, content-based analysis, subscriber feedback-based methods, sender reputation-based schemes, and traffic analysis technologies [16][17].

2.2 Network Security in Vehicular Ad-Hoc Network

The vehicular ad-hoc network is an emerging area of networking. It is a subset of Mobile ad-hoc networks. The vehicular ad-hoc network provides Vehicles to Vehicles (V2V), Rode-side Unit to Rode-side Unit(R2R), and, Vehicles to rode-site Unit (V2R) communication[30]. In recent years, more accident cases have been found significantly. Due to this, roads are found to be more congested and busy. With the help of dedicated short-range communication (DSRC), VANETs establish communication between various vehicles that are changing their direction frequently. Vehicles directly communicate with different vehicles and send information regarding traffic jams, and warning messages with the roadside side unit (RSU) which is fixed equipment inroads

Vehicles communicate with another vehicle directly if there is a wireless connection available; it is called single-vehicle-to-vehicle (V2V) communication. If there is a lack of direct connection between them then, forward data from one vehicle to another vehicle until

it reaches the proper destination its called multi-hop vehicle-to-vehicle (V2V) communication.

Security is more crucial in VANETs due to the lack of centralization, and dynamic topology. Due to this, it is difficult to identify malicious, misbehaving, and faulty nodes or cars in the network. Mainly trust models are based on verifying vehicles and providing appropriate trust value to all vehicles. Trust should be provided either directly or indirectly

Hong x. Et al. [18], proposed establishing a trust management scheme with three aspects, which are policy control, proactive trust establishment, and social network impact on the network. Policy control considers entry trust and data trust attributes are used. Proactive trust considers the traditional approach according to the past communication history of that car/node for the trust value. Social trust considers the nearest vehicle's opinion and sets up trust in another vehicle.

Jorge h. Et al. [19], proposed a watchdog algorithm with intrusion detection techniques for establishing trust management. In that source, a node sends packets to the neighbor node and monitors that node with IDs. It is forward that packets maintain their trust value in the trust table otherwise the trust value of that node is. The drawback of this technique is to create collision in the network, and monitor that node until that forward or drop. It contains ins huge monitoring history of the neighbor node if it has a large number of neighbor nodes. Cong l. Et al. [20], proposed trustworthiness based on incident reports in V2V communication and forward to those vehicles. Crowdsourcing capabilities are used for evaluating the trustworthiness value of vehicles. The global view can broadcast individual vehicles' trust value in CSC. Future work includes security and privacy issues using unique identification and public key infrastructure mechanisms.

Zhou w. Et al. [21], proposed to establish a Dynamic trust token based on the method used for cooperation with nodes. Both cryptography mechanisms should be included for packet integrity with the symmetric and asymmetric algorithms and apply the neighborhood watchdog algorithm which generates tokens for checking packet is valid or not. In this algorithm protection of packets during communication is increased and the latency of the network is decreased. It is a cooperative packet forwarding scheme applied for communication. It is set up for instant trust at runtime communication. The drawback of this technique is not encourage misbehaving nodes to be well-behaved, does not punish malicious nodes, and does not reward the right nodes.

Subir b. Et al. [22], proposed id-based techniques used for the verification of cars with the public key without a certificate. The proxy server provides message authentication and trust management. Safety messages delivered through RSU (road site unit) and id-based signature properties imply the proxy signature with ECDSA. In this technique authentication and trust, management is dynamic and untrustworthiness. RSU which had a proxy signature pre-stored management scheme.

Tahani g. Et al. [23], proposed a Markov chain model for establishing trust management. This model not only considers the behavior of a node in dynamic trust metric but monitors all constraints activity of that node. Each thing is monitoring an updating trust metric table of its neighbor nodes. Misbehaving and selfish vehicles are identified with this mechanism. It uses time intervals and the number of transitions with other nodes in trust management. This system uses a stress and trust evolution system for the trust model. In this global trust should not be established which is the future scope of this mechanism. Yu-Chih w. Et al. [24], proposed a road site unit (RSU) and beacon-based trust management system to improve safety and location privacy. This technique's motto is quick message opinion and prevents sending and forwarding from the internal malicious node. This technique takes a

decision quickly and provides an opinion in less time Drawback of this mechanism is not able to compare trust value with another node.

Felix g. Et al. [25], proposed to provide trust based on the TRIP (Trust and Reputation infrastructure-based proposal) algorithm for malicious bogus or false information in the network. If the node is malicious then reject and drop packets from those nodes/cars. Fuzzy logic classifies and categorizes trust values as per operation and advertisement messages. The reputation score is computed with three pieces of information: previous experience, surrounding vehicles, and recommendation of the central authority. Three types of trust values: Not trust-reject all packets, +/- trust-accept but not forward, and trusted- accept and forward. The drawback of this mechanism is hard to maintain the trust value and behavior of the node, and we cannot identify whether the node is honest or malicious

Tahani g. Et al. [26], proposed a trust model that depends on public key infrastructure for trust management and distributed cluster algorithm. VANET dynamic demilitarized zone is a set of vehicles of neighbors, and there is a registration authority (that authentication to each vehicle within a particular cluster head (CH). This technique prevents malicious and unknown vehicles which are authenticated within the cluster. Cluster is defined as trust level and vehicle CA. The clustering algorithm is based on two parameters: the trust metric used for defining the trust level of vehicles and the mobility metric.

Qing d. Et al. [27], proposed an event-based reputation model for filtering bogus messages. Role-based reputation mechanism is used to determine whether the incoming message is significant and trustworthy to the drivers/cars. It enhances trust in the vehicular network. This technique includes random waypoint which is not a sufficient technique for reputation. In the future, we can apply fuzzy logic for calculating the reputation value for an event.

Tahani g. Et al. [28], proposed a hybrid trust model for determining trust metrics. Two terms used for monitoring trust: are cooperation with other vehicles in the network and broadcasting legitimate data. The fuzzy-based algorithm is used to decide the honesty of vehicles and filter out malicious vehicles. One trusted neighbor to issue CA in the PKI is distributed among some vehicles. Trustworthy value is calculated by monitoring the relativeness of monitor vehicles' to neighbor vehicles. Yi-Ming c. Et al. [29], proposed Beacon-based trust management (BTM) to prevent internal attackers from sending false or bogus messages in privacy enhancement in the network. The protocol is used to evaluate direct and indirect trust management. Direct trust in trustworthiness value and indirect trust opinion transmitted from multiple vehicles. Dempster Shafer's evidence theory is used for numerical computation.

Chen c. Et al. [30], proposed data as an aggregation mechanism to establish trust in the network. It is used to check the quality of the message. This method uses multiple existing identity-based aggregation methods like concatenate signature base, onion signature base, and hybrid signature base combined into one aggregate signature summing them mathematically. It eliminates signature redundancy of aggregation signature, flexibility to aggregation function no harmful effects in the network. The drawback of this algorithm is signature size is much higher and no comparative mechanism.

Rashmi s. et al. [31], the proposed trust-based approach in clustering and ant colony routing, clustering techniques create a cluster and consider the position, direction, and speed of relative vehicles manage networks/cars. Cluster head (CH) considering real-time update location and trust value of those vehicles. Direct and Indirect trust to establish the trust. Trust management to find out the most trusted path between two nodes of a VANET.

2.3 Network Security in Wireless Sensor Network

The Wireless Network is the network in which the communication between the sender and receiver host is possible without any cable connection. The wireless network is advanced to a wireless network because it reduces the cost of the extra link connected to the particular host in the network. The different devices in the wireless network are performing their role efficiently to maintain a reliable connection between the source to destination

Wireless sensing element networks are more vulnerable as compared to wired or wireless communication however currently, the number of analyses focuses on the field of WSN, therefore in the future, the WSN will be the most utilized network in a real application in every were. In this section, we have a tendency to study a range of the latest papers on security and energy-connected issue and their resolution in the WSN field those are as follows.

In this paper [32], we aim to provide a mechanism that is used to detect the vampire attack in WSN. Vampire attacks can be defined as the transmission and composite of a message that causes more energy to be consumed by the network than if an honest node transmits a message of identical size to the same destination. We discuss the effect of vampire attacks on Ad-hoc On Demand Vector Routing (AODV). AODV is a reactive protocol between nodes that needs to communicate. The routing messages do not contain information about the entire route path, but only about the source and destination.

In this paper [33], a novel trust routing scheme is proposed. Multi-agents cooperate to decide the trust route. Trust is the degree of belief about the future behavior of other entities, which is based on the experience of the nodes. If sensor nodes want to communicate or exchange key data, it is necessary to establish a trust relationship between nodes to ensure reliable data exchange. Trust is related to many factors, such as hop count node behavior node's residual energy. To enhance security and reliability in sensor networks routing scheme is proposed in the paper. Trust can be interpreted as belief, reputation, probability, and trustworthiness. Trust routing reflects the trustworthy degree of the routing path. In a sensor network, in addition to the traditional hop count, routing trustworthiness is related to many factors, such as the node's residual energy and attack behavior.

In this paper [34], we have analyzed a set of algorithms collectively known as CAWS and MES-1. CAWS (cellular automata-based security algorithms) [35], which includes key management under cellular automata algorithm and secure data communication algorithm, which require less amount of memory and less amount of simple computation. Modern Encryption Standard (MES-1) [35], [36] is an advanced cryptography method that is used for double encryption and decryption. Modern Encryption Standard (MES-1), the method is achieved by file splitting into two parts, which is encrypting and encrypting the divided section of the file in a different form by using cipher methods such as TTJSA and DJSA cipher techniques.

This paper [37], focuses on the change in an existing routing protocol to bound loss due to Vampire attacks at the time of forwarding of packets. The third aspect, this paper targets to surface outcomes measuring the functionality of various representative protocols in the existence of an original Vampire. It is the source routing, and beacon routing protocol also a logical ID-based sensor network routing protocol that shows the effects of Vampire attacks.

In this paper [38], a continuous secure scheme is proposed for static HSN (Heterogeneous Sensor Networks) (CSS-SH). The formation of clusters in HSNs is as follows: Each L-

sensor selects an H-sensor whose Hello message has the best signal strength as its cluster head. Simultaneously each L-sensor also records other H sensors from which it has received Hello messages, and these H-sensors will serve as backup cluster heads in the case that the cluster head fails. In a cluster, the cluster head can communicate with all L-sensors directly, but an L-sensor may need one or more hops to communicate with its cluster head.

In this paper [39], we consider how routing protocols, even those designed to be secure, lack protection from these attacks, which we call Vampire attacks since they drain life. These attacks are distinct from previously studied DoS, reduction of quality (RoQ), and routing infrastructure attacks as they do not disrupt immediate availability, but instead work overtime to entirely disable a network. The author defines a Vampire attack as the composition and transmission of a message that causes more energy to be consumed by the network than if an honest node transmits a message of identical size to the same destination, although using different packet headers.

This paper [40], has represented various problems associated with security attacks that coincide within the wireless sensing element network at various layers of protocol design. This paper carries with it numerous constraints in wireless sensing element networks, security availability, and numerous varieties of network attack and their interference mechanism at entirely different layers of the protocol stack of wireless sensing element networks have been presented consecutively. This paper presents a complete introduction regarding wireless sensing element networks, sensing element network communication design, and numerous applications of wireless sensing element networks.

In this paper [41], they propose a trust-aware distance vector routing protocol (T-AODV) to guard the wireless sensing element network from wormhole attacks. Through experimental results, their proposed approach tested the network potency regarding improved packet delivery ratio, end-to-end delay, and range of node to the destination.

2.4 Network Security in the Internet of Things

Internet of Things (IoT) can be seen as a pervasive network of networks: various heterogeneous entities both physical and virtual interconnected with any other entity or entities through unique addressing schemes, interacting with each other to provide/request all kinds of services. IoT technology is expected to pave the way for groundbreaking applications in a diversity of areas such as healthcare, security and surveillance, transportation, and industry, and integrate advanced technologies of communication, networking, cloud computing, sensing, and actuation.

Given the enormous number of connected devices that are potentially vulnerable, highly significant risks emerge around the issues of security, privacy, and governance; calling into question the whole future of IoT. IoT applications are expected to affect many aspects of people's lives, bringing about many conveniences; however, if security and privacy cannot be ensured, this can lead to some undesired consequences. This survey focuses on the security aspects of IoT and discusses current IoT security solutions.

Tahir et al. [42] proposed a novel ICMetric-based framework for securing IoT. ICMetric is based on cryptography keys. The idea behind ICMetric is a mathematical and statistical extraction of device features that, when combined, uniquely characterize the performance of a given electronic device. The ICMetric includes two stages of calculations: the calibration stage is applied only once per application domain employing some known

circuits as a calibration set, while the operation stage is applied each time an encryption key is desired for a given circuit. In this paper, a solution for providing security of IoT is presented based on the ICMetric technology coupled with Secure Remote Rabbit Protocol, which secures entities and their intercommunications to provide security for IoT

Liu et al. [43] proposed a solution for IoT security based on the principles of a biological immune system. A biological immune system has served as a role model for building IoT security. The proposed solution uses a dynamic defense frame for IoT security, since static defense strategies may prove to be inadequate. They propose a circular defense with five links: security threat detection, danger computation, security responses, security defense strategy formulation, and security defense. The links in the frame are correlated with relative data of IoT security. The behavior of a biological immune system is applied to establish links in the proposed scheme solution to make the proposed approach adaptive to the IoT environment

In [44], Zhou and Chao developed a novel architecture for media-aware traffic security and designed and evaluated the proposed security-critical traffic management scheme. The novel media-aware traffic security architecture (MTSA) meets the information security requirements for multimedia communication, computation, and service in the IoT environment. The solution is adapted to respond to the challenges and requirements of multimedia system security in the IoT environment. It is stated that the distributed privacy paradigm for MTSA, in which the authority, cost, and encryption are obtained in a decentralized manner, is a novel solution.

Lessa dos Santos et al. [45] introduced an architecture to enable constrained devices to use Datagram Transport Layer Security (DTLS) with mutual authentication to communicate with Internet devices. This security architecture for IoT is based on a third-party device called the Internet of Things Security Support Provider (IoTSSP) and two main mechanisms for 6LoWPAN Border Router (6LBR) to redirect the DTLS handshaking to the IoTSSP

Kothmayr et al. in [46] described IoT security solutions. They proposed the use of dedicated hardware to enable security in constrained devices. The main idea is to use the trusted-platform modules (TPM) added to each constrained device. Although this hardware supports RSA, the most widely used public key cryptography, and works on top of the standard low-power communication stacks, it does not endorse the CoAP recommendation of using ECC cryptography. Furthermore, the proposed architecture provides message integrity, confidentiality, and authenticity with affordable energy, end-to-end latency, and memory overhead, which make it a feasible security solution for the emerging IoT.

Xin described a mixed encryption algorithm used in IoT security transmission [47]. The proposed algorithm provides information integrity, confidentiality, and non-repudiation on the data transmission for IoT using the crucial hybrid technology, which takes into account the characteristics of a symmetric key and asymmetric key. Encryption is a required step for the security of the Internet. The Advanced Encryption Standard (AES) and Elliptic Curve Cryptography (ECC) are broadly used for information security. The proposed algorithm uses AES algorithm encryption for its simplicity, velocity, and reliability.

Leo et al., in [48], proposed an architecture model mainly devoted to deploying and managing a federated environment for authority delegation mechanism, identity-based capability, and dynamic context information. The primary element of the proposed solution is the Secure Mediation GateWay (SMGW) which is dedicated to managing the secure communication for both intraSMGW and interSMGW nodes, under the assumption that the IoT space can be divided into the intraSMGW and interSMGW categories

3. Information Security Survey

Information security, sometimes shortened to InfoSec, is the practice of preventing unauthorized access, use, disclosure, disruption, modification, inspection, recording, or destruction of information. It is a general term that can be used regardless of the form the data may take (e.g., electronic, or physical). Information security's primary focus is the equal protection of the confidentiality, integrity, and availability of data (also known as the CIA triad) while maintaining a focus on efficient policy implementation, all without hampering organizational productivity.

In information security, confidentiality "is the property, that information is not made available or disclosed to unauthorized individuals, entities, or processes. While similar to "privacy," the two words are not interchangeable. Instead, confidentiality is a component of privacy that is implemented to protect our data from unauthorized viewers. Examples of confidentiality of electronic data being compromised include laptop theft, password theft, or sensitive emails being sent to the incorrect individuals [49]

In information security, data integrity means maintaining and assuring the accuracy and completeness of data over its entire lifecycle. This means that data cannot be modified in an unauthorized or undetected manner. This is not the same thing as referential integrity in databases, although it can be viewed as a particular case of consistency as understood in the classic ACID model of transaction processing. Information security systems typically provide message integrity in addition to data confidentiality.

3.1 Information Security in Cloud Computing

Cloud computing emerges as a computational model on the internet as well as distribution design. Its main goal is secure and quick data storage for sensitive information. Cloud computing supports ubiquitous, appropriate, network access to a united pool of resources, i.e. servers, storage, networks, services, and applications. Cloud Computing is a widely used technique for data storage on demand but involves risks such as data security, privacy protection, access control, and data confidentiality. The present study is a survey of the popularly used encryption techniques that are helpful to secure sensitive information on the cloud. A discussion of the fundamental challenges and issues/characteristics of cloud computing has been done. Identification of security and privacy issues within this framework are highlighted.

The study of the widely used encryption techniques helpful in securing sensitive information on the cloud is debated. The scope has been set for academicians and researchers. Diverse versions of the encryption techniques were surveyed and analyzed to identify optimization features for cloud security.

Amlan Jyoti Choudhury, Pardeep Kumar, Mangal Sain, Hyotaek Lim, and Hoon Jae Lee[50], focused on security user authentication issues. This paper proposed the robust two-step user authentication process where the user is verified before entering into the cloud. Even a user can change his/her password whenever it is required. This technique restricts many attacks like denial of service, and it provides efficiency to cloud computing

Ari Jueland, Opera [51], proposed a framework that secures cloud data by integrity and verification for data availability. A major obstacle in cloud computing is obtaining security

and operational risks, i.e. hardware failure, malware, software bugs, etc. So, protection for outsourced data on the cloud is necessary. There is also another issue in public clouds is availability and reliability assurances. Mariana Carroll, Alta van der Merwe, and Paula Kotzé[52], focused on easing cloud security risk as a necessary step to ensure a secure cloud environment. It provided an overview of cloud computing security risks, i.e. attention to ensure integrity, completeness, and availability of data as well as benefits that help to build standards, processes, logical access, network security, physical security, and compliance.

Deyan Chen and Hong Zhao[53], analyze the data security and privacy protection issues in cloud computing. Because of these issues, many large organizations still don't share their data on the cloud. Privacy protection is shared data with protecting personal information. The most fundamental challenges are access control and separation of sensitive data. This paper proposed different techniques to ensure access, i.e. fine-grained access authorization. Nirmala, R. K. Shivanadhan, and R. Shanmuga Lakshami[54] focused the inactive information's arrangement security is to be done by encoding the information or data and sending it to a server that's how confidentiality and integrity of data are implemented by encoding the data. Further, the general idea of distinguishing security issues that influence the cloud environment and related work that is done in the territory of truthfulness are discussed.

The advantage of such an act is to have data access to only approved customers or owners as presented by Arockiam, L.; Monikandan, S. [55]. Encryption with obscurity; both concepts are exclusive for securing information in storage management. Obstruction is a process that masquerades unauthorized clients by implementing an exact numerical capacity or utilizing programming techniques. Encryption is the procedure of changing the comprehensible content into a mixed-up structure utilizing a calculation and a key. The disorder is the same as encryption. Applying encryption and muddling systems on the cloud information will give more assurance against unapproved usage of data.

Kavuri, S.K.S.V.A.; Kancherla, G.R.; Bobba, B.R.[56] presented that the client can gain focused information. Such as reports, media, or another sort of proof utilizing an outsider-produced validation key. To reduce the security issues of cloud computing servers; an advanced message-based confirmation process is defined. It is the process only approved users can have access to data by identifying his/her identity using message uprightness.

Kaur, R.; Singh, R.P. [57], discussed how to secure the level of distributed storage security a security model is proposed having three stages private, public, and hybrid. Some encryption techniques are implemented in these three stages to cover areas regarding security factors. Two-tier security structural arrangement for a hybrid. Decoding and encryption techniques for the public stage and last the exclusive token era instrument is implemented for the special stage. All these give an advantage of enhancing security, and integrity in cloud computing.

Rajani Kanth Tuvalu, Lakshmi Mundane [58], Privacy, trust, and access control are the key factors for maintaining security in cloud computing. Distributed computing has many benefits regarding sharing data among untrusted users. The granularity of access control with a successful encryption technique is explained and discussed. Furthermore, different access control models for disseminated computing are examined.

3.2 Information Security in Big Data

Today the information security (IS) of data mining is a crucial and comprehensive issue for

organizations of different spheres and sizes main challenges of Big Data IT are the management of large amounts of heterogeneous information and providing its availability. Big Data protection against unauthorized access and corruption (keeping its confidentiality and integrity), as well as availability maintenance, form the key research priorities in this field. The issues related to providing these Big Data features are considered in the paper. The existing approaches to their solution are analyzed. Some concepts for their improvement while designing the secure Big Data mining algorithm are formulated by IS properties.

Using the technology of Big Data collecting and mining increased significantly over the past decade. This is because a significant amount of data is generated in the daily activities of the various organizations and, hence, the volume of organizational information resources grows dramatically.

On the other hand, the violations of IS and its separately allocated subdomain — cybersecurity — have been a serious problem for organizations in recent years. Attackers find more sophisticated ways to penetrate the corporate networks (intranets), discovering the Ir new vulnerabilities that were not eliminated promptly. Modern perimeter and its endpoints do not guarantee the defense of the entire network and, as a consequence, its users, provided services, and information resources are subject the great IS risks

J. Chen and F. Tian developed a system called NiagaraCQ, which made it possible to respond to repeated requests to the database (DB) in larger-scale systems [59]. In such systems, many requests are identical. By thorough, one can reduce the number of the necessary computing and communication resources, which to some extent solves the problem of data availability. The adaptive scheme of increasing query grouping is applied in the NiagaraCQ system that is used to find the optimal mapping between every new request and the group, in which this request can be included

Another approach to providing access to Big Data networks is described by C. Olston and J. Widom [60]. The presented distributed model has nodes, using which the data stream is sent to the central unit, being responsible for the processing of all the incoming requests. At some times, the volume of data. To avoid this situation, the authors propose to set filters that limit the data transfer rate from the separate network nodes. However, this technique allows the request is respond with some approximation (because not all the requests are processed) and, therefore, only works in cases that do not require a high query processing precision.

D. Estrin and R. Govindan proposed a technique and showed how decomposable functions of minimum, maximum, mean, sum, and count can be calculated concerning the network architecture [61]. The architecture in this context consists of three components: collectors, analyzers, and dumps. The collectors gather information about the network attributes (for example, the number of nodes), which are calculated continuously, periodically, or upon the occurrence of specific events (described as an exception in a trigger). The analyzers are used at the moment when the network issue reports are sent from the collectors for subsequent scanning of network resources.

H. Kargupta's work [62] uses the results of the matrix perturbation theory and spectral analysis of large random matrices for searching the filtering method of random additive noise. The authors show that when the noise variance takes a sufficiently small value, and the original data have correlated components, then the spectral filtering of the covariance matrix can reveal the original data with reasonable accuracy. However, this method is subjected to the known-sample attack where the attacker has multiple independent

samples from the initial data distribution and assumes that the perturbation matrix is orthogonal.

3.3 Information Security in Wireless Network

This section will describe a survey of information security issues in wireless networks from a novel perspective. It figures out information security issues inherent to wireless networks because of their design simplicity. Distributed Denial of Services (DDoS) in its various forms is being increasingly used as a type of attack, with the advent of technical expertise DDoS has been camouflaged into forms more devastating and more difficult to mitigate. There are specific motivational factors for attackers that need to be focused on a comprehensive defense mechanism. Piyush *et al.* have given an approach where the source and destination nodes understand-to-end verification to check if the destination nodes intended have received packets transmitted or not. On detecting anomalous behavior, the network initiates procedures for finding malicious nodes. The strength of the phenomenon lies in the condition that each node is surrounded by more trusted nodes than malicious nodes which are not always a reality [63].

Chen *et al.* proposed an approach relying on two related algorithms viz. key management algorithm that incorporates gossip protocol and a Detection algorithm utilizing aggregate signature. Here every node, part of the session has to make a proof of received messages. On suspecting some anomalous behavior, the source may initiate a checkup process for nodes in the pathway, based upon data returned by the checkup process; it (source node) traces the compromised node with the help of diagnostic algorithms. The computational cost of this approach is a little bit high because of methods of detection viz. gossip protocol and aggregate signatures[64].

A slightly less effective but straightforward approach is proposed by Arshad *et al.* which uses passive acknowledgment in its pure form promiscuous mode of the communication channel is utilized which enables all nodes to check any transmitted packet no matter to whom it is intended, ensuring sender nodes that packets they have sent to their neighbors for forwarding are unrewarded [65]. Ming-Yang *et al.* have proposed a grading method for nodes by ABM (Anti Blackhole Mechanism), in ABM nodes are evaluated for suspicious values; suspicious values are the difference between RREQ, and RREP counts for a given node. Here all nodes perform ABM, and intermediate nodes are debarred from replying to RREQs, so if there is a node with neither destination nor source and broadcasts cast RREQ for a specific route, but forwards an RREP for the specific route, its suspicious index is raised in the neighboring nodes abnormal table. Eventually, when a suspicious index bypasses a threshold, a block message is generated by this neighboring node to all other nodes of the network to isolate this node [66].

Shukla *et al.* proposed a framework for starting actual communication source sends some prologue messages to the destination making it aware that there is a communication to be started for it, at the end the communication destination nodes repeat this procedure to inform about the number of packets received by it; if the no. of packets lost exceeds the acceptable range limit, the process of malicious node discovery is started by accumulating responses from monitoring nodes and networks [67]. Oscar *et al.* have used an algorithm that is based on the principle of flow conservation and the accusation of nodes for their behavior. Here certain threshold defines well-behaving nodes and misbehaving nodes. However, based on this approach a network cannot be made misbehaving nodes free as ascertaining nodes behavior has time complexity involved, and a node can have misbehaved before data being accumulated for its behavior [68]. Ahmad Tariq has proposed a 4 step technique to detect and isolate malicious to ensure that they cannot be a part of any communication anymore. This technique relies upon two detection procedures viz. local and cooperative detection models for the identification of malevolent nodes[69].

One of the earliest studies on trusted routing was undertaken by Marti *et al.* [70]. Their

approach consisted of 3 parts viz. the routing protocol, path rater compo, net, and a watchdog component. The watchdog component determines if a neighboring node's actions are according to normal behavior or are deviating from the protocol (e.g., not forwarding packets, tampering with packets, etc). This information was fed to the pathrater component to determine the quality of routes which subsequently helped the router component to make proper route decisions. Vicente Segura and Javier Lahuerta have conducted a study on the economic incentives of DDoS attacks. In their study, they first tried to understand the factors affecting DDoS attackers and then proposed an economic model for it. They have given a mathematical model also to assess the economic incentive of attackers and consequently have applied it as well on some survey data collected by themselves [71].

Liu et al. have made an effort to model attackers' psychology, their goals for the attack, and, their strategy to counter the effects of the attack and predict a robust, proactive model for Cyberdefense [72]. Fultz et al. have proposed their model based on game theory, in which attackers are trying to infiltrate the security system to deny services whereas defenders are simultaneously trying hard to seize their effort. The study shows that only the threat of criminal prosecution is enough to distract an increasing number of attackers system becomes imbalanced [73]. These issues are inherent in wireless networks because of their flexible nature and openness. Out of various issues related to wireless networks confidentiality is concerned with robust encryption algorithms. Integrity in wireless networks is relatively easy to compromise but available mechanisms viz. Checksum etc. to protect integrity is enough for protection of the data integrity. Availability indeed is an aspect of the security issue that remains a challenge for research communities and professionals. DoS, DDoS, Blackhole, Grey hole, etc. are forms of attacks being used increasingly and frequently day by day. We have tried to look into the motivation of attackers as well; a broad classification is also presented to model the intentions of the attacker and their psychology.

4. Conclusion

In this paper, we aim to provide a comprehensive overview of various approaches to addressing Networks and Internet security issues. The field of network security has grown increasingly complex due to the rapid evolution of technologies and the diverse range of applications they support. To address these challenges, we explore security concerns in several specific contexts, including LTE technologies, Vehicular Ad-Hoc networks networks Sensor Networks (WSNs), and the Internet of Things (IoT). Each of these domains presents unique security challenges, and this paper surveys the existing methods and strategies designed to counter these vulnerabilities. For instance, we examine encryption techniques, intrusion detection systems, and authentication protocols as key measures for securing network communication and preventing unauthorized access.

Additionally, this paper delves into Information Security methods applied to emerging technologies such as Big Data and Cloud Computing. The vast amount of data generated and stored in these systems introduces significant risks, including data breaches, unauthorized data manipulation, and service interruptions. We review the state-of-the-art methods for protecting information integrity and confidentiality in these contexts, including advanced cryptographic algorithms, data anonymization techniques, and secure multi-party computations. By addressing both network and information security from these perspectives, this paper provides a holistic view of the current landscape and highlights potential directions for future research to combat the ever-evolving security threats in modern technological ecosystems.

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