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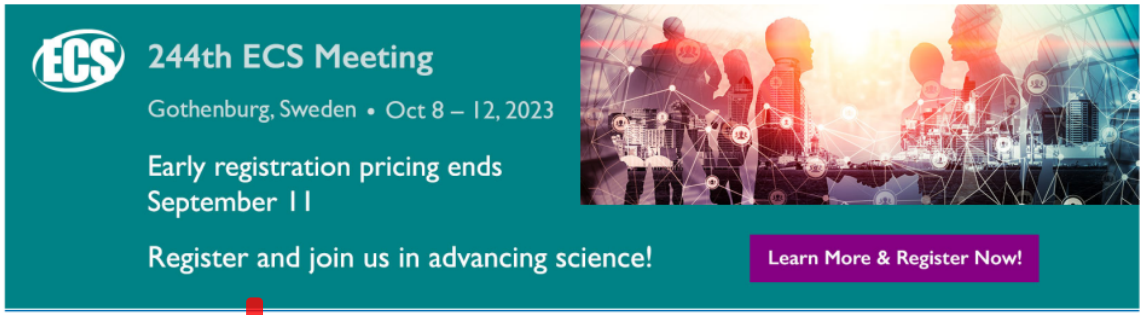

Protecting Data By Socket Programming Steganography

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Abstract. This paper aims to observe the techniques and methods of securing data using socket programming steganography. This work observes the development of the art of steganographic techniques which focus on computer network devices by visiting articles which published in journals and proceedings. The results obtained that the development of steganography is not only on data which stored on local disk, but also utilizes computer network devices to transmitting the data. Steganography techniques have several modifications in the algorithm to secure data on the network using stegnography that uses socket programming. This results show the evolutions of steganography techniques on network devices for better data security.

1. Introduction

Network path is a line that connects communication between many entities. This line provides services for sending data from sender to receiver. The data sent will run through a network layer mechanism that is processed by a program called socket programming.

In data protection, cryptographic techniques can provide security by encrypting and decrypting [1]. Even so attacks on a ciphertext can still occur. This is because of cryptography mechanism, the product of cryptography still shows suspicion of an undisclosed message. Steganography comes by hiding messages into a cover. The advantage of steganography is that unauthorized people are not realize of the existence of a message [1]. The role of the internet and communication networks is now accommodating in the exchange of data and information. This is very beneficial for accelerating the delivery of a message. But keep in mind that the confidentiality of data and information is something that needs attention. Steganography mechanism can provide power in hiding data through a cover [2].

In 2003, a study conducted a merging of steganography with network technology called Network Steganography [3]. This is become new approach for hiding data in TCP/IP network layer protocol [1]. This will result in data hiding becoming stronger and more difficult to detect. TCP / IP has been perfectly developed and offers many performance improvements for secure access and data transfer [4]. Many devices that are currently connected to each other are easily controlled using socket programming [5]. The main point of network steganography is to use 7 protocols in Open System Interconnection (OSI) as a cover of data [3]. This article presents the development of protection data using steganography with it's algorithm modifications and using socket programming at the network layer.

2. Method

The research method used in this paper is visitting articles which published in journals and proceedings. Several phases of work are planning, condutcing and reporting, which can be illustrated as below in figure 1.

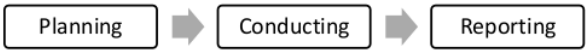

Figure 1. Phases of Work

Planning phase is the initial stage in conducting research. This phase determines the topic and the Research Question (RQ) which will be used as a guide for the process of conducting research. As a topic taken is socket programming steganography. The RQs used are "Are there research activities on stegaography in the network carried out at transport or network layers?" as RQ1, "What is the steganography process that takes place at the transport or network layer?" as RQ2 and "is there still a possibility of developing steganography in the network layer?" as RQ3.

Conducting stage is the implementation of research activities. In this phase several steps are taken, the strategy of selecting literature, filtering literature and assessing quality, as shown in figure 2.

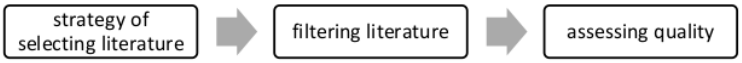

Figure 2. Implementation Phase

The first step in the implementation phase is a strategy for selecting literature, which is preceded by selecting keywords and sources of literature. After determining the source and search restriction, the next step is to determine the keywords which are then followed by filtering literature. The quality assessment done by accessing the scimagojr.com to see the quality of the journals that contain the articles obtained. The next step in quality assessment is to synthesize the articles obtained by reading the entire article so that it matches the topic and the research question specified.

3. Results and Discussions

The source of the literature used is a database of research articles contained on the page scholar.google.com. The literature search process is limited to articles in the form of journals and proceeding conferences with the publication year 2015 to three quarter 2019.

In this research, articles are searched by using several keywords. The first keyword is "steganography in socket programming", which on the search page produces 345 results. In the first search, after reading the title and abstract 14 articles were produced which were quite suitable and could be fully downloaded. The second term is "steganography socket programming" which features 261 articles. In the second search produced 14 articles that can be fully downloaded. And the third term is "steganography in transport layer", in the third search found 20 articles that can be fully downloaded. So, it obtained 48 articles with relevance based on the title and abstract. There are 40 papers published in journals which 4 papers published in Q1 journals, 2 papers published in Q2 journals, 4 published papers in Q3 journals, 4 published papers in Q4 journals and 26 papers published in journals unknown refered to schimagojr.com. 8 papers are published in proceeding conferences.

In quality assessment phase, it resulted 30 articles that are quite relevant and there are 12 articles that are relevant to the question reaearch. Table 2 shows relevance between the topic and question research.

Tabel 1. Paper's Qualifications

	Journal Qualification					Total
	Q1	**Q2**	**Q3**	**Q4**	**Unknown**	
Paper's on Journal	4	2	4	4	26	40
Proceeding Conference	-	-	-	-	-	8

Table 2. Relevance of articles to the topic

No	Paper's Index	Qualification	Topic Discussion		
			Cryptography	Steganography	Transport / Network Layer
1	[6]	-	Y	Y	-
2	[1]	-	Y	Y	Y
3	[7]	-	-	-	Y
4	[8]	-	Y	Y	Y
5	[2]	-	-	Y	Y
6	[3]	Q4	-	Y	Y
7	[9]	Q3	Y	-	Y
8	[10]	Q4	Y	-	Y
9	[11]	-	-	Y	Y
10	[12]	-	Y	-	Y
11	[13]	Q1	-	Y	Y
12	[14]	-	Y	Y	Y
13	[15]	-	Y	-	Y
14	[16]	-	-	Y	-
15	[17]	-	Y	Y	-
16	[18]	-	-	Y	-
17	[19]	-	-	Y	-
18	[20]	-	-	Y	-
19	[21]	-	Y	-	-
20	[22]	Q1	-	Y	-
21	[23]	-	-	-	-
22	[24]	-	Y	Y	-
23	[25]	-	Y	Y	-
24	[26]	Q1	Y	-	-
25	[27]	-	Y	-	-
26	[5]	Q1	-	-	-
27	[4]	Q3	-	-	-
28	[28]	Q1	-	-	-
29	[29]	Q2	-	Y	-
30	[30]	Q3	-	Y	-

Symbol description: "Y" means the obtained article discusses subject based the column, "-" means the opposite. In the discussion section will describe the results of the previous process to answer the Research Question. In the articles obtained, there are 12 articles that are relevant to the topic of discussion and questions on the research question. In this paper there are some research on data security at the transport layer or network layer. Articles that conduct data security research using steganography, cryptography or both by carrying out the process at the transport layer are 8 articles, 1 article processes data security at the network layer and 3 articles conduct observational studies on the mechanism of data security in the communication path.

Table 2 shows that there are developments in securing data in the network layer using cryptographic or steganographic techniques. There are studies that use a combination of cryptography and steganography to provide multiple layers of security [1] [8] [14].

The process of developing data security using steganography, the majority is done only limited to the application layer. In the article obtained there are several studies in the form of study. Among them observing the development of steganography in the physical layer or link layer by proposing packet modifications and timings on delivery by providing time delay [2]. Other observations conducted security observations on ad-hoc networks that suggested adding a mechanism for key exchange and securing data with cryptographic techniques [12]. As a monitoring tool for packet data flow on transmission media a study uses NS3 to monitor the form of packets sent in IPv4 [7].

Commonly the development of steganography carried out on the network is more likely in the transport layer. Generally it is mentioned that data security is done by encryption and steganography techniques, even though it is applied to the socket [10]. An application using the RSA encryption technique to form a cipher and then transform into binary and split into 20 bits per packet [1]. Other studies have modified the Transport Transport Control Protocol (STCP) by performing multi-level security using secret matrix, secret keys, hidden signatures and steganography [8]. Modification of other shipments via the transport layer is done by permutation of the packet using a table agreed upon by the sender and receiver [3]. Reduction in packet size is also done to prevent transmission bottlenecks in the transmission [9]. Another approach is to use headers in TCP / IP as a cover, but this can only hold 4 characters in each communication transmission [11]. Another proposal is to streamline the data which is done serially by using a cross-layer framework [13].

The process of securing data is still dominated by applying cryptographic and steganographic mechanisms. Even though it is applied in packet size modification, embedding in the header, the secret message that is still embedded is still flowing in the communication path. A study suggests an observation of data traffic in order to analyze packet size anomalies [15].

Data security in the communication channel is expected to continue. This is a number of proposals reported in previous studies, namely by combining several cryptographic and steganographic techniques [6] [10], algorithm modification [13], package size modification [1] [9], insert in to the cover header [11], the addition of a digital signature [14] making observations on data traffic is also needed to see streaming data anomalies [15].

4. Conclusion

From the activities, conclusions can be drawn about evolutions of steganographic techniques in the network layer are such as follows. The development of data security uses steganography combined with cryptography to provide data security, authenticity and integrity of the data as well as provide information trust for the recipient. The development of steganography is also done by modifying the package size, modification by giving additional time to send and using headers as cover data for messages. Even so, the steganography mechanism that is carried out in majority still streams the message data through the transmission media, even though the message has been kept it's confidentiality and has a cover. To support the form of data security running through communication media, a concept of developing data security by observing data traffic conditions for decision making in solving packet size before sending via transmission media are ight be an idea for further developing.

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