



Importance and Future of Network Security

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Abstract—Network security has become more important to personal computer users, organizations, and the military. With the advent of the internet, security became a major concern and the history of security allows a better understanding of the emergence of security technology. The internet structure itself allowed for many security threats to occur. The architecture of the internet, when modified can reduce the possible attacks that can be sent across the network. Knowing the attack methods, allows for the appropriate security to emerge. Many businesses secure themselves from the internet by means of firewalls and encryption mechanisms. The businesses create an “intranet” to remain connected to the internet but secured from possible threats.

The entire field of network security is vast and in an evolutionary stage. The range of study encompasses a brief history dating back to internet's beginnings and the current development in network security. In order to understand the research being performed today, background knowledge of the internet, its vulnerabilities, attack methods through the internet, and security technology is important and therefore they are reviewed.

I. INTRODUCTION

The world is becoming more interconnected with the advent of the Internet and new networking technology. There is a large amount of personal, commercial, military, and government information on networking infrastructures worldwide. Network security is becoming of great importance because of intellectual property that can be easily acquired through the internet. There are currently two fundamentally different networks, data networks and synchronous network comprised of switches. The internet is considered a data network. Since the current data network consists of computer-based routers, information can be obtained by special programs, such as “Trojan horses,” planted in the routers. The synchronous network that consists of switches does not buffer data and therefore are not threatened by attackers. That is why security is emphasized in data networks, such as the internet, and other networks that link to the internet. Based on this research, the future of network security is forecasted. New trends that are emerging will also be considered to understand where network security is heading.

II. USES OF NETWORK SECURITY

System and network technology is a key technology for a wide variety of applications. Security is crucial to networks and applications. Although, network security is a critical requirement in emerging networks, there is a significant

lack of security methods that can be easily implemented. There exists a “communication gap” between the developers of security technology and developers of networks. Network design is a well-developed process that is based on the Open Systems Interface (OSI) model. The OSI model has several advantages when designing networks. It offers modularity, flexibility, ease-of-use, and standardization of protocols. The protocols of different layers can be easily combined to create stacks which allow modular development. The implementation of individual layers can be changed later without making other adjustments, allowing flexibility in development. In contrast to network design, secure network design is not a well-developed process. There isn't a methodology to manage the complexity of security requirements. Secure network design does not contain the same advantages as network design. When considering network security, it must be emphasized that the whole network is secure. Network security does not only concern the security in the computers at each end of the communication chain. When transmitting data the communication channel should not be vulnerable to attack. A possible hacker could target the communication channel, obtain the data, and decrypt it and re-insert a false message. Securing the network is just as important as securing the computers and encrypting the message.

When developing a secure network, the following need to be considered [1]:

1. Access – authorized users are provided the means to communicate to and from a particular network
2. Confidentiality – Information in the network remains private
3. Authentication – Ensure the users of the network are who they say they are
4. Integrity – Ensure the message has not been modified in transit
5. Non-repudiation – Ensure the user does not refute that he used the network

An effective network security plan is developed with the understanding of security issues, potential attackers, needed



level of security, and factors that make a network vulnerable to attack [1]. The steps involved in understanding the composition of a secure network, internet or otherwise, is followed throughout this research endeavor.

To lessen the vulnerability of the computer to the network there are many products available. These tools are encryption, authentication mechanisms, intrusion-detection, security management and firewalls. Businesses throughout the world are using a combination of some of these tools. "Intranets" are both connected to the internet and reasonably protected from it. The internet architecture itself leads to vulnerabilities in the network. Understanding the security issues of the internet greatly assists in developing new security technologies and approaches for networks with internet access and internet security itself.

The types of attacks through the internet need to also be studied to be able to detect and guard against them. Intrusion detection systems are established based on the types of attacks most commonly used. Network intrusions consist of packets that are introduced to cause problems for the following reasons:

- To consume resources uselessly
- To interfere with any system resource's intended function
- To gain system knowledge that can be exploited in later attacks

The last reason for a network intrusion is most commonly guarded against and considered by most as the only intrusion motive. The other reasons mentioned need to be thwarted as well.

III. BRIEF HISTORY OF INTERNET

The birth of the interne takes place in 1969 when Advanced Research Projects Agency Network (ARPANet) is commissioned by the department of defense (DOD) for research in networking.

The ARPANET is a success from the very beginning. Although originally designed to allow scientists to share data and access remote computers, e-mail quickly becomes the most popular application. The ARPANET becomes a high-speed digital post office as people use it to collaborate on research projects and discuss topics of various interests. The InterNetworking Working Group becomes the first of several standards-setting entities to govern the growing network [10]. Vinton Cerf is elected the first chairman of the INWG, and later becomes known as a "Father of the Internet." [10]

During the 1980s, the hackers and crimes relating to computers were beginning to emerge. The 414 gang are raided by authorities after a nine-day cracking spree where they break into top-secret systems. The Computer Fraud and Abuse Act of 1986 were created because of Ian

Murphy's crime of stealing information from military computers. A graduate student, Robert Morris, was convicted for unleashing the Morris Worm to over 6,000 vulnerable computers connected to the Internet. Based on concerns that the Morris Worm ordeal could be replicated, the Computer Emergency Response Team (CERT) was created to alert computer users of network security issues.

In the 1990s, Internet became public and the security concerns increased tremendously. Approximately 950 million people use the internet today worldwide [3]. On any day, there are approximately 225 major incidences of a security breach [3]. The protocol contains a couple aspects which caused problems with its use. These problems do not all relate to security. They are mentioned to gain a comprehensive understanding of the internet protocol and its shortcomings. The causes of problems with the protocol are:

1. Address Space
2. Routing
3. Configuration
4. Security
5. Quality of Service

A. Security Timeline

When IPv6 was being developed, emphasis was placed on aspects of the IPv4 protocol that needed to be improved. The development efforts were placed in the following areas:

1. Routing and addressing
2. Multi-protocol architecture
3. Security architecture
4. Traffic control

The IPv6 protocol's address space was extended by supporting 128 bit addresses. With 128 bit addresses, the protocol can support up to 3.4×10^{38} machines. The address bits are used efficiently in this protocol because it simplifies addressing configuration.

B. Attacks through the current Intertet Protocol IPvt

There are four main computer security attributes. They were mentioned before in a slightly different form, but are restated for convenience and emphasis. These security attributes are confidentiality, integrity, privacy, and availability. Confidentiality and integrity still hold to the same definition. Availability means the computer assets can be accessed by authorized people [8]. Privacy is the right to protect personal secrets [8]. Various attack methods relate to these four security attributes. Table 1 shows the attack methods and solutions.

C. Figures and Tables



Table 1: Attack Methods and Security Technology

Computer Security attributes	Attack Methods	Technology for Internet Security
Confidentiality	Eavesdropping, Hacking, Phishing, DoS and IP Spoofing	IDS, Firewall, Cryptographic Systems, IPSec and SSL
Integrity	Viruses, Worms, Trojans, Eavesdropping, DoS and IP Spoofing.	IDS, Firewall, Anti-Malware Software, IPSec and SSL.
Privacy	Email bombing, Spamming, Hacking, DoS and Cookies	IDS, Firewall, Anti-Malware Software, IPSec and SSL.
Availability	DoS, Email bombing, Spamming and Systems Boot Record Infectors	IDS, Anti-Malware Software and Firewall.

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Network security is an important field that is increasingly gaining attention as the internet expands. The security threats and internet protocol were analyzed to determine the necessary security technology. The security technology is mostly software based, but many common hardware devices are used. The current development in network security is not very impressive. Combined use of IPv6 and security tools such as firewalls, intrusion detection, and authentication mechanisms will prove effective in guarding intellectual property for the near future. The network security field may have to evolve more rapidly to deal with the threats further in the future.

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