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Network Security and wireless sensor networks using in the Human Immune System

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ABSTRACT

Network Security has become very important in today's world, as a result of which various methods are adopted to bypass it. Network administrators need to keep up with the recent advancements in both the hardware and software fields to prevent their as well as the user's data. Wireless sensor network is one of the most growing technologies for sensing and performing the different tasks. Such networks are beneficial in many fields, such as emergencies, health monitoring, environmental control, military, industries and these networks prone to malicious users' and physical attacks due to radio range of network, un-trusted transmission, unattended nature and get access easily. Security is a fundamental requirement for these networks. In this paper, our centre of attention is on physical attacks and issues in wireless sensor networks. Through this review, easily identify the purpose and capabilities of the attackers. Further, we discuss well-known approaches of security detection against physical attacks. Human immune system, which survives under dynamic changing conditions and provides protection against biological viruses and bacteria. By taking immune system as an analogy, we propose Formal methods may also be useful for proving properties on the specified models. These proofs could be performed automatically, using model checkers, or interactively through proof tools. Our solution not only overcomes limitations of traditional security solutions, but also enhances overall security by providing protection at each stage of the attack timeline. It functions in proactive and also reactive manner and has ability to learn and improve its strategies, equivalent to what human immune system does against viruses and bacteria.

Keywords: Network Security, Wireless sensor network, Formal methods, attack timeline, Physical attacks.

INTRODUCTION

Natural system that survives in different dynamic environments is human immune system. At the lowest level the human body consists of cells. These cells form tissues. The tissues combine to form organs and organs are combined to form complete systems, like immune, digestive, and reproductive system. Cells in the immune system

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are produced by special areas in the body, like the thymus and the bone marrow. There are different damaging agents (i.e. viruses, bacteria) that can destroy the body. But the immune system is able to identify, locate and remove these damaging agents what allows the body to survive and maintain itself for many years. The immune system enables humans to survive in different environments. Over the past few years research community and commercial product vendors came up with many solutions to protect network from intrusions: antivirus, firewall, spyware and authentication mechanism. These solutions still face the challenges of inherent system flaws, OS bugs, and social engineering attacks. Intrusion Detection Systems (IDS) fail to provide adequate protection due to the fact that they cannot detect and respond to all intrusions in real-time, because most of them require customization and human reaction by system administrators. It is very difficult for a system administrator to analyze large logs generated by network traffic, identify the attack, and respond in real-time. Traditional IDSs open a window of opportunity for attacker, because of the delay in attack identification and response by system administrators. The major drawback in all available solutions is their methodology of protection. First, the methodology is reactive: reaction starts when there is already an intrusion in progress. Second, there is no learning mechanism at a network level to study and learn about intrusions and provide protection against the same intrusion to the rest of the network. Third, there are no preventive measures taken against foreseeable threats that can turn into intrusions based on existing vulnerabilities in the system, which become the cause of zero-day attacks. A number of researchers have applied the immune system features in securing information systems. The following features of the immune system are applied in information security systems: learning to detect new viruses; detecting viruses locally; identifying viruses; classifying and eliminating viruses autonomously; multiple layered protection system; different cells being able to detect different viruses and few 'self' cells being able to detect multiple viruses; and remembering discovered viruses. There is a need to revisit existing methodologies with an intension to improve them by applying the concept of immune system to achieve comprehensive security for information systems. In this paper we present the system that functions in six stages to secure information systems against intrusions. Our system is based on the concepts of prevention, anticipation, recognition, response, recovery and learning as similar as in human immune system. We used formal methods along with different sensors to achieve the desired results of our comprehensive security system.

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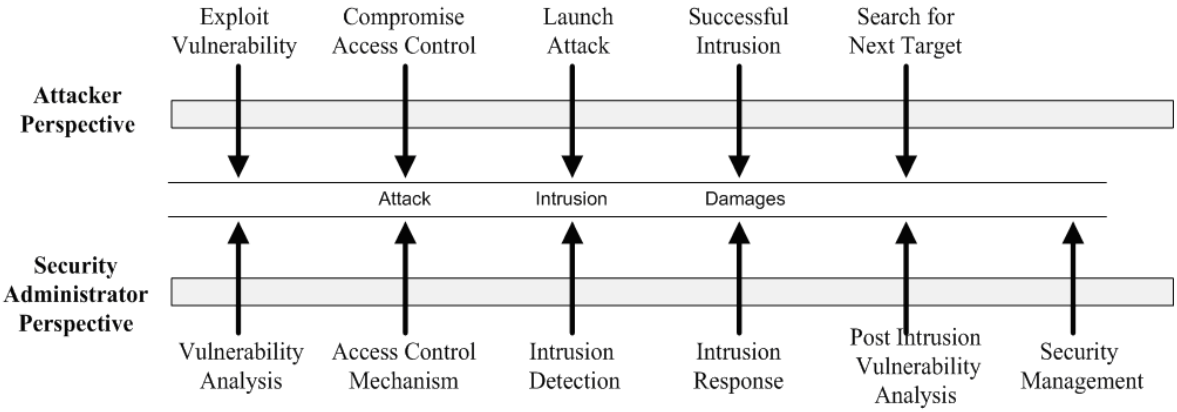

Immune System Features for Information Security Systems

Every information system is recommended to have deterrence measures, prevention measures, detection measures, response measures, and recovery. The immune system has the following features that
can be applied to information security systems:
(i) Distributed – The T-cells and B-cells can detect infections and viruses locally without doing any global coordination. In this work we model this Feature by having mobile agents act as cells in Vulnerability Analysis System (VAS), Intrusion. Detection System (IDS), Intrusion Response System (IRS), and Security Management (SMS).
(ii) Multi-layered – The immune system has multiple defence layers, defence in depth. This is modelled by having multiple protections at the boundary of a system.
(iii)Identification – The immune systems marks all the cells that belong to the body as 'self'. We model this feature in our system by providing 'self' identities to all the objects of a system and by registering them in the database. There are agents that monitor the system and when they find objects that are not having 'self' identities are handled according to the system's policy.

FORMAL METHODS

Clarke &Wing in 1996 described formal specification languages and analysis tools as the two main reasons of using formal methods in software development. They discussed that informal and semi-formal techniques of software development are not sufficient to develop reliable systems due to the complex nature of software systems and issues related to these approaches. The first issue of informal and semi-formal techniques is the natural language in which software systems are specified. The words and sentences in natural languages can be interpreted as having to multiple meanings. These words have specific meanings within s specific context. Therefore, the issues like ambiguities, incompleteness and contradictions are

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always present in the systems specified by using natural languages. The second issue is the lack of automatic or semi-automatic tools for the analysis of specifications written in natural language.

CONCLUSION

This paper has presented network security system and wireless sensor networks that apply features from the immune system to secure systems. The system has features that help an information security system learn to adapt to dynamic environments.

This system uses secure mobile agents to protect systems and networks. These formal methods are generated and tested using the negative and clonally selection algorithms. The secure mobile agents that pass these tests are allowed to perform the vulnerability analysis, intrusion detection,

Intrusion response and security management services. We have implemented the system using secure formal methods which take input from sensors like, SNORT, Firewall, Nessus, and Osiris. Mobile agents process the inputs from sensors and based on subsystem functionality perform various activities and finally output (protective measure) using sensors again. Our implementation shows significant improvements in network security and as by deploying system, there is significant reduction in intrusions, as our system catered them using multifaceted approach, similar to the human immune system.

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