Algorithmic calculation of reliability of computer network topologies

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Abstract

As the era of the Internet of Things (IoT) has just begun, an increasing number of endpoints are connected to the internet. This includes desktops, smartphones, cloud services, various gadgets like IP-cameras, embedded devices, etc. Many IoT devices are equipped with little or no security protection. These days, the meaning of IoT changes unfortunately: the Internet of Threats. The European Commission plans to design a labeling system to categorize such networks by the level of security. Measuring the level of security becomes even more demanding, but currently there is no objective method to do this automatically. The available measuring methods are usually subjective and are based on the surveying of system operators. In this presentation, we demonstrate a method for this measurement that is independent of such subjective surveys. This method is based on the theory of P-graphs. Former researches proved that the P-graph methodology is an efficient way of modeling and optimizing similar problems. By using the proposed method it is possible to improve the security level of computer networks based on objective parameters. The method is capable of maximizing the reliability of a network or a service based on the original architecture, and of satisfying financial constraints. A statistical approach is followed. The method considers the history of already known vulnerabilities, which are available from the official National Vulnerability Database (NVD). The NVD database provides Common Vulnerability Scores, which represents the severity of these vulnerabilities. We proposed a method that calculates an accumulative score, the vulnerability score. The vulnerability score is used during the optimization. Computer network topologies are represented by standard network diagrams. These diagrams are transformed into P-graphs. Running the optimization on this P-graph, reliability is calculated. The optimal solution can be reflected in the original topology, therefore we can provide the level of security, and

make recommendations on the enhancement of the network's reliability. The algorithm in this presentation is proved to a case study.

Keywords: IoT, security level, vulnerability

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