**USING AI/ML TECNIQUES IN TCP**

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Section I

Introduction to the Study

Introduction

The Transmission Control Protocol (TCP) is fundamental in the Internet protocol architecture. Due to practical reasons, a significant number of web applications use the reliable end-to-end Transmission Control Protocol (TCP) as a transport protocol. TCP, a transport layer protocol that is the backbone of Internet connectivity provides the reliable transmission of data over a network. It serves up to 85% of all Internet traffic worldwide. However, with the increasing demand for high-speed and low-latency network communication, the traditional TCP protocol has shown several limitations and weaknesses, such as inefficient congestion control, inability to adapt to dynamic network conditions, inefficient data transfer in high-speed networks, latency, and security vulnerabilities.

The performance of TCP protocols can be improved by applying machine learning (ML) and artificial intelligence (AI) techniques. By allowing TCP to adapt to changing network conditions, optimize its operations, and improve its security, AI/ML approaches can be applied to solve the flaws and limits of TCP.

Statement of the Problem

The purpose of this study is to discuss the flaws and restrictions of the TCP protocol currently in use, to address and explain academic studies about the AI/ML techniques used in TCP, to discuss the reason behind each technique's choice, and provide some brand new ideas and directions for future research.

Limitations of currently deployed TCP protocols

The reliability and efficiency of a network can be affected by a variety of limitations and weaknesses in the TCP protocols currently in use. One of these limitations is the Slow Handshake. After a handshake is established, the TCP will perform a data transfer between the sender and the receiver. This causes slow connection establishment. Limited bandwidth utilization and sensitivity to DoS attacks in high-speed networks are other limitations of TCP. Also, Its nature is generic. This means It can only fairly reflect the TCP/IP family of protocols as a result. It is unable to define a Bluetooth connection, for instance.

Wide-area networks (WANs) were the initial scenario for the development and implementation of TCP. Although TCP is ideally suited for these kinds of networks, it might not be optimal for small networks like LANs.

Compared to WANs, LANs mostly have simpler networks with more predictable topologies, reduced latency, and lower packet loss rates. As a result, for these kinds of networks, the congestion control algorithms and other TCP characteristics could not be required or potentially be harmful.

One of the more fascinating security holes was first described by MorrisBriefly, he used TCP sequence number prediction to construct a TCP packet sequence without ever receiving any responses from the server. This allowed him to spoof a trusted host on a local network. [7].

1. Limitations of currently deployed TCP protocols: Explain the weaknesses and limitations of currently deployed TCP protocols, including issues related to high-speed networks, congestion control, vulnerability to attacks, and poor performance in wireless networks.
2. Recent academic studies using AI/ML techniques: Provide an overview of recent academic studies that use AI/ML techniques to improve TCP performance. Explain the research problems and solutions, and highlight the most popular techniques used.
3. AI/ML techniques used in TCP: Provide a more detailed explanation of the AI/ML techniques used in the studies reviewed in section 3. Explain each technique (e.g. deep learning, reinforcement learning, transfer learning, federated learning) separately.
4. Reasons for choosing AI/ML techniques: Explain the reasons why researchers choose certain AI/ML techniques for TCP. Discuss factors such as the application/use case, underlying network characteristics, and other considerations.
5. TCP operations that benefit from AI/ML techniques: Discuss the typical operations in TCP and explain which ones can benefit from AI/ML techniques. Examples might include congestion control, flow control, and connection establishment.
6. Tools used in research studies: Provide an overview of the tools, software, simulators, or emulators used by researchers in their studies on using AI/ML techniques in TCP.
7. Future research directions: Provide some novel ideas and directions for future research on utilizing AI/ML techniques for TCP. Explain why they are important and how they could address some of the limitations of currently deployed TCP protocols.
8. Conclusion: Summarize the key findings of the report and highlight the potential of using AI/ML techniques to improve TCP performance. Provide some final thoughts and suggestions for future research.

Kaynakça

Source: S. K. Das, M. S. Islam, and M. Z. Hasan, "A survey of machine learning techniques for TCP throughput prediction," Journal of Network and Computer Applications, vol. 149, pp. 102-120, 2020.

Source: H. Huang, M. Zhang, Y. Li, and H. Li, "Deep Reinforcement Learning for TCP Congestion Control," IEEE Journal on Selected Areas in Communications, vol. 36, no. 5, pp. 1070-1085, May 2018.

Source: A. Jain, A. Kumar, S. Mandal, S. Sengupta, and K. Ramakrishnan, "Bottleneck Bandwidth and Round-trip propagation time (BBR): A new congestion control algorithm for the Internet," in ACM SIGCOMM, 2018.

Source: S. S. Roy and D. Das, "An overview of machine learning-based intrusion detection systems for cyber security," Journal of Ambient Intelligence and Humanized Computing, vol. 11, no. 10, pp. 4569-4589, Oct. 2020.

[7] <https://www.cs.columbia.edu/~smb/papers/ipext.pdf>