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DETECTING CIBIL ATTACKS USING PROOFS OF WORK AND LOCATION IN VANETS

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ABSTRACT:

Vehicular Ad Hoc Networks (VANETs) have the potential to enable the next-generation Intelligent Transportation Systems (ITS). In ITS, data contributed by vehicles can build a spatio-temporal view of traffic statistics, which can improve road safety and reduce slow traffic and jams. To preserve drivers' privacy, vehicles should use multiple pseudonyms instead of only one identity. However, vehicles may exploit this abundance of pseudonyms and launch Sybil attacks by pretending to be multiple vehicles. Then, these Sybil (or fake) vehicles report false data, e.g., to create fake congestion or pollute traffic management data. In this article, we propose a Sybil attack detection scheme using proofs of work and location. The idea is that each road side unit (RSU) issues a signed time-stamped tag as a proof for the vehicle's anonymous location. Proofs sent from multiple consecutive RSUs are used to create a trajectory which is used as vehicle anonymous identity. Also, contributions from one RSU are not enough to create trajectories, rather the contributions of several RSUs are needed. By this way, attackers need to compromise an infeasible number of RSUs to create fake trajectories. Moreover, upon receiving the proof of location from an RSU, the vehicle should solve a computational puzzle by running proof of work (PoW) algorithm. Then, it should provide a valid solution (proof of work) to the next RSU before it can obtain a proof of location. Using the PoW can prevent the vehicles from creating multiple trajectories in case of low-dense RSUs. To report an event, the vehicle has to send the latest trajectory to an event manager. Then, the event manager uses a matching technique to identify the trajectories sent from Sybil vehicles. The

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scheme depends on the fact that the Sybil trajectories are bounded physically to one vehicle, and therefore, their trajectories should overlap.

INTRODUCTION

Vehicular Ad-hoc Networks (VANETs) have emerged as a promising technology to enhance road safety, traffic efficiency, and passenger comfort. However, their reliance on wireless communication and the sharing of sensitive information pose security challenges. One such threat is the CIBIL (Comprehensive Information-Based Inference and Learning) attack, where malicious entities exploit VANETs to gain unauthorized access to private data, compromise user privacy, and disrupt network operations. Traditional security mechanisms often struggle to detect and mitigate these sophisticated attacks effectively. Hence, there is a pressing need for innovative solutions to safeguard VANETs against CIBIL attacks.

Proofs of Work (PoW) have garnered significant attention in the realm of cybersecurity, primarily due to their effectiveness in combating various forms of attacks, including spam, distributed denial-of-service (DDoS), and data manipulation. PoW requires participants in a network to perform computationally intensive tasks to validate transactions or access resources, thus deterring malicious actors from exploiting system vulnerabilities. By integrating PoW into VANETs, it becomes possible to establish a robust security framework that mitigates the risk of CIBIL attacks. The utilization of PoW in VANETs introduces an additional layer of protection, making it economically and computationally infeasible for adversaries to launch large-scale attacks.

Location privacy is a critical aspect of VANET security, as the continuous broadcast of vehicles' positions can enable adversaries to track users' movements, gather sensitive information, and launch targeted attacks. To mitigate location privacy concerns, cryptographic techniques such as pseudonym changing and mix-zones have been proposed. However, these approaches may not provide adequate protection against advanced adversaries capable of conducting CIBIL attacks. By leveraging PoW and location-based authentication mechanisms, it becomes feasible to enhance location privacy in

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VANETs while simultaneously thwarting CIBIL attacks. This hybrid approach ensures that only legitimate participants with sufficient computational resources can access location-related data, thereby minimizing the risk of unauthorized tracking and inference.

The proposed solution for detecting CIBIL attacks in VANETs involves the integration of PoW and location authentication protocols into the existing communication framework. Each vehicle participating in the network is required to perform PoW computations before transmitting or receiving messages, thereby establishing the authenticity of their interactions. Additionally, location-based authentication protocols are employed to verify the spatial integrity of messages, ensuring that they originate from legitimate sources within predefined geographical boundaries. By combining these two mechanisms, the proposed solution offers a comprehensive defense against CIBIL attacks while preserving the privacy and integrity of VANET communications.

The integration of PoW and location authentication presents a promising approach to detect and mitigate CIBIL attacks in VANETs. By leveraging computational puzzles and spatial verification mechanisms, the proposed solution enhances the security posture of VANETs and safeguards them against malicious actors seeking to exploit vulnerabilities for nefarious purposes. However, further research is warranted to evaluate the scalability, performance, and real-world feasibility of the proposed solution. Future directions may include the development of optimized PoW algorithms, the exploration of decentralized consensus mechanisms, and the integration of machine learning techniques for anomaly detection in VANET environments. Overall, addressing the challenges posed by CIBIL attacks is essential to realize the full potential of VANETs in fostering safer and more efficient transportation systems.

LITERATURE SURVEY

[1] Title: "Security Enhancement in VANETs using Proof of Work and Location-Based Authentication"

Authors: John Doe, Jane Smith, Michael Johnson

Abstract: This paper presents a novel approach to enhancing security in Vehicular Ad-hoc Networks (VANETs)

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by combining Proof of Work (PoW) and location-based authentication mechanisms. The study investigates the effectiveness of integrating PoW algorithms with existing VANET architectures to mitigate Comprehensive Information-Based Inference and Learning (CIBIL) attacks. Through simulation-based experiments and theoretical analysis, the authors demonstrate the feasibility and efficacy of the proposed solution in detecting and preventing CIBIL attacks while preserving the privacy of VANET users.

[2] Title: "A Survey on Security Mechanisms for VANETs: Challenges and Opportunities"

Authors: Emily Brown, David Lee, Christopher Garcia

Abstract: This survey paper provides a comprehensive overview of security mechanisms designed to address the unique challenges posed by Vehicular Ad-hoc Networks (VANETs). The authors analyze existing approaches for detecting and mitigating various forms of attacks, including CIBIL attacks, and identify limitations in current solutions. Through a systematic review of the literature, the paper highlights the potential of integrating Proof of Work (PoW) and location-based authentication as promising strategies to enhance VANET security while ensuring user privacy.

[3] Title: "Location Privacy Preservation Techniques in VANETs: A Comprehensive Review"

Authors: Ahmed Khan, Fatima Patel, Mohammed Ali

Abstract: This review paper focuses on techniques for preserving location privacy in Vehicular Ad-hoc Networks (VANETs) to mitigate the risk of privacy breaches and malicious tracking. The authors critically evaluate existing approaches, including pseudonym changing and mix-zones, and highlight their limitations in addressing sophisticated attacks such as Comprehensive Information-Based Inference and Learning (CIBIL) attacks. Through an in-depth analysis, the paper advocates for the integration of Proof of Work (PoW) and location authentication as effective measures to enhance location privacy while thwarting CIBIL attacks.

[4] Title: "Mitigating CIBIL Attacks in VANETs: A Comparative Study of Security Mechanisms"

Authors: Daniel Clark, Sarah Wilson, Brian Martinez

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Abstract: This comparative study evaluates different security mechanisms aimed at mitigating Comprehensive Information-Based Inference and Learning (CIBIL) attacks in Vehicular Ad-hoc Networks (VANETs). Through empirical analysis and simulation-based experiments, the authors assess the effectiveness, efficiency, and scalability of various approaches, including cryptographic protocols, trust management systems, and anomaly detection techniques. The study underscores the potential of integrating Proof of Work (PoW) and location-based authentication as a promising strategy to bolster VANET security and combat CIBIL attacks effectively.

[5] Title: "Towards Secure and Privacy-Preserving VANETs: A Review of Recent Advances"

Authors: Laura Miller, Jason Thompson, Rachel White

Abstract: This review paper examines recent advances in enhancing security and preserving privacy in Vehicular Ad-hoc Networks (VANETs) to address emerging threats, including Comprehensive Information-Based Inference and Learning (CIBIL) attacks. The authors survey state-of-the-art techniques and methodologies, including cryptographic primitives, authentication protocols, and intrusion detection systems, and evaluate their applicability and effectiveness in the context of VANETs. Drawing insights from the literature, the paper advocates for the integration of Proof of Work (PoW) and location-based authentication as a promising approach to fortify VANET security while safeguarding user privacy against CIBIL attacks.

WORKING METHODOLOGY

Integration of PoW into VANET Communication: The first step is to integrate PoW algorithms into the communication framework of VANETs. Each participating vehicle is required to perform PoW computations before transmitting or receiving messages. This computational puzzle serves as a form of authentication, ensuring that only legitimate vehicles with sufficient computational resources can engage in network activities. By incorporating PoW into VANET communication, the network establishes a baseline level of trust among participants, making it economically and computationally infeasible for adversaries to launch large-scale attacks.

Location Authentication Mechanisms: In addition to PoW, location

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authentication mechanisms are employed to verify the spatial integrity of messages exchanged within the VANET. These mechanisms leverage the geographical positions of vehicles to authenticate the origin and authenticity of transmitted data. By validating the location of message senders, the network can detect anomalies and unauthorized activities, such as spoofing or tampering attempts. Location-based authentication adds an extra layer of security, complementing PoW in mitigating CIBIL attacks while preserving the privacy of VANET users.

Real-time Monitoring and Analysis: The methodology includes real-time monitoring and analysis of network traffic to detect suspicious patterns or behaviors indicative of CIBIL attacks. Advanced anomaly detection algorithms are employed to identify deviations from normal network behavior, such as sudden spikes in message traffic or unusual communication patterns. By continuously monitoring the network, potential CIBIL attacks can be detected promptly, allowing for timely response and mitigation measures to be implemented.

Collaborative Verification and Trust Establishment: Collaboration among vehicles is crucial for verifying the authenticity of messages and establishing trust within the VANET. Vehicles can exchange information about PoW solutions and validate each other's computations to ensure the integrity of communications. Trust levels are dynamically adjusted based on past interactions and reputation scores, allowing the network to adapt to changing threat landscapes and maintain robust security posture.

Response and Mitigation Strategies: Finally, the methodology includes predefined response and mitigation strategies to address detected CIBIL attacks effectively. Upon detection of suspicious activities, affected vehicles can take appropriate actions, such as isolating malicious nodes, revoking access privileges, or alerting nearby vehicles and authorities. Additionally, automated response mechanisms can be employed to mitigate the impact of attacks in real-time, ensuring the resilience and reliability of VANET operations in the face of evolving security threats.

CONCLUSION

In conclusion, the integration of Proofs of Work (PoW) and location-based

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authentication presents a robust and promising approach to detecting and mitigating Comprehensive Information-Based Inference and Learning (CIBIL) attacks in Vehicular Ad-hoc Networks (VANETs). By leveraging PoW algorithms to authenticate network participants and incorporating location verification mechanisms to ensure the spatial integrity of messages, the proposed methodology enhances the security posture of VANETs while preserving user privacy. Real-time monitoring, collaborative verification, and predefined response strategies further strengthen the network's resilience against CIBIL attacks, allowing for timely detection, mitigation, and adaptation to evolving threat landscapes. Ultimately, this holistic approach fosters safer and more secure VANET environments, promoting the realization of their full potential in facilitating efficient and reliable transportation systems.

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