



Enhanced Adaptive ACKnowledgement - A Special Intrusion- Detection System for MANETs

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ABSTRACT

The migration to wireless network from wired network has been a global trend in the past few decades. The mobility and scalability brought by wireless network made it possible in many applications. Among all the contemporary wireless networks, Mobile Ad hoc Network (MANET) is one of the most important and unique applications. On the contrary to traditional network architecture, MANET does not require a fixed network infrastructure; every single node works as both a transmitter and a receiver. Nodes communicate directly with each other when they are both within the same communication range. Otherwise, they rely on their neighbors to relay messages. The self-configuring ability of nodes in MANET made it popular among critical mission applications like military use or emergency recovery. However, the open medium and wide distribution of nodes make MANET vulnerable to malicious attackers. In this case, it is crucial to develop efficient intrusion-detection mechanisms to protect MANET from attacks. With the improvements of the technology and cut in hardware costs, we are witnessing a current trend of expanding MANETs into industrial applications. To adjust to such trend, we strongly believe that it is vital to address its potential security issues. In this paper, we propose and implement a hybrid cryptography technique of diffie hell man key exchange algorithm with new energy constraint based intrusion-detection system named two tier Enhanced Adaptive ACKnowledgment (EAACK) specially designed for MANETs. Compared to contemporary approaches, EAACK demonstrates higher malicious-behavior-detection rates in certain circumstances while does not greatly affect the network performances.

Keywords :

I. INTRODUCTION

In natural mobility and scalability, wireless networks are always preferred since the first day of their invention. Owing to the improved technology and reduced costs, wireless networks have gained much more preferences over wired networks in the past few decades.

Finally Mobile Ad hoc Network (MANET) is a collection of mobile nodes equipped with both a wireless transmitter and a receiver that communicate with each other via bidirectional wireless links either directly or indirectly. Industrial remote access and control via wireless networks are becoming more and more popular these days.

2. RELATED WORK

1) Watchdog: Marti et al. proposed a scheme named Watchdog that aims to improve the throughput of network with the presence of malicious nodes. In fact, the Watchdog scheme is consisted of two parts, namely, Watchdog and Pathrater. Watchdog serves as an IDS for MANETs. It is responsible for detecting malicious node misbehaviors in the network. Watchdog detects malicious misbehaviors by promiscuously listening to its next hop's transmission. If a Watchdog node overhears that its next node fails to forward the packet within a certain period of time, it increases its failure counter. Whenever a node's failure counter exceeds a predefined threshold, the Watchdog node reports it as misbehaving. In this case, the Pathrater cooperates with the routing protocols to avoid the reported nodes in future transmission.

2) TWOACK: With respect to the six weaknesses of the Watchdog scheme, many researchers proposed new approaches to solve these issues. TWOACK proposed by Liu et al. is one of the most important approaches among them.

3) AACK: Based on TWOACK, Sheltami et al. proposed a new scheme called AACK. Similar to TWOACK, AACK is an acknowledgment-based network layer scheme which can be considered as a combination of a scheme called TACK (identical to TWOACK) and an end-to-end acknowledgment

scheme called ACKnowledge (ACK). Compared to TWOACK, AACK significantly reduced network overhead while still capable of maintaining or even surpassing the same network throughput. The end-to-end acknowledgment scheme in ACK is same route. Within a predefined time period, if the source node S receives this ACK acknowledgment packet, then the packet transmission from node S to node D is successful.

3) EXISTING SYSTEM

A. ACK

As discussed before, ACK is basically an end-to-end acknowledgment scheme. It acts as a part of the hybrid scheme in EAACK, aiming to reduce network overhead when no network misbehavior is detected. In ACK mode, node S first sends out an ACK data packet Pad1 to the destination node D. If all the intermediate nodes along the route between nodes S and D are cooperative and node D successfully receives Pad1, node D is required to send back an ACK acknowledgment packet Pak1 along the same route but in a reverse order. Within a predefined time period, if node S receives Pak1, then the packet transmission from node S to node D is successful.

Otherwise, node S will switch to S-ACK mode by sending out an S-ACK data packet to detect the misbehaving nodes in the route.

B. S-ACK

The S-ACK scheme is an improved version of the TWOACK

scheme proposed by Liu et al. The principle is to let every three consecutive nodes work in a group to detect misbehaving nodes. For every three consecutive nodes in the route, the third node is required to send an S-ACK acknowledgment packet to the first node. The intention of introducing S-ACK mode is to detect misbehaving nodes in the presence of receiver collision or limited transmission power.

S-ACK mode, the three consecutive nodes (i.e., F1, F2, and F3) work in a group to detect misbehaving nodes in the network. Node F1 first sends out S-ACK data packet Psad1 to node F2. Then, node F2 forwards this packet to node F3. When node F3 receives Psad1, as it is the third node in this three-node group, node F3 is required to send back an S-ACK acknowledgment packet Psak1 to node F2. Node F2 forwards Psak1 back to node F1. If node F1 does not receive this acknowledgment packet within a predefined time period, both nodes F2 and F3 are reported as malicious. Moreover, a misbehavior report will be generated by node F1 and sent to the source node S. Nevertheless, unlike the TWOACK scheme, where the source node immediately trusts the misbehavior report,

EAACK requires the source node to switch to MRA mode and confirm this misbehavior report. This is a vital step to detect false misbehavior report in our proposed scheme.

C. MRA

The MRA scheme is designed to resolve the weakness of Watchdog when it fails to detect misbehaving nodes with the presence of false misbehavior report. The false misbehavior report can be generated by malicious attackers to falsely report innocent nodes as malicious. This attack can be lethal to the entire network when the attackers break down sufficient nodes and thus cause a network division. The core of MRA scheme is to authenticate whether the destination node has received the reported missing packet through a different route. To initiate the MRA mode, the source node first searches its local knowledge base and seeks for an alternative route to the destination node. If there is no other that exists, the source node starts a DSR routing request to find another route. Due to the nature of MANETs, it is common to find out multiple routes between two nodes. By adopting an alternative route to the destination node, we circumvent the misbehavior reporter node. When the destination node receives an MRA packet, it searches its local knowledge

D. Digital Signature

As discussed before, EAACK is an acknowledgment-based IDS. All three parts of EAACK, namely, ACK, S-ACK, and MRA, are acknowledgment-based detection schemes. They all rely on acknowledgment packets to detect misbehaviors in the network. Thus, it is extremely important to ensure that all acknowledgment packets in EAACK are authentic and untainted. Otherwise, if the attackers are smart enough to forge acknowledgment packets, all of the three schemes will be vulnerable. With regard to this urgent concern, we incorporated digital signature in our proposed scheme. In order to ensure the integrity of the IDS, EAACK requires all acknowledgment

packets to be digitally signed before they are sent out and verified until they are accepted. However, we fully understand the extra resources that are required with the introduction of digital signature in MANETs. To address this concern, we implemented both DSA and RSA digital signature schemes in our proposed approach. The goal is to find the most optimal solution for using digital signature in MANETs.

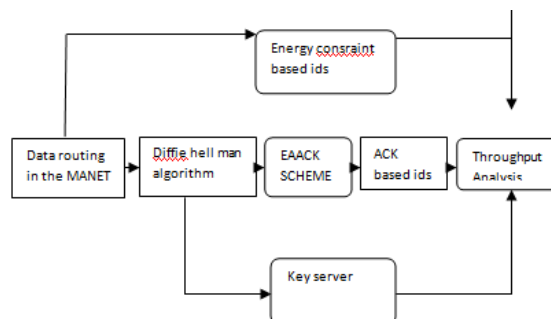
4. PROPOSED SYSTEM

In the effort to prevent the attackers from initiating forged acknowledgment attacks, we extended our research to incorporate digital signature in our proposed scheme. Although it generates more ROs in some cases, as demonstrated in our experiment, it can vastly improve the network's PDR

when the attackers are smart enough to forge acknowledgment packets. We think that this tradeoff is worthwhile when network security is the top priority. In order to seek the optimal DSAs in MANETs, we implemented both DSA and RSA schemes in our simulation. Eventually, we arrived to the conclusion that the DSA scheme is more suitable to be implemented in MANETs.

To increase the merits of our research work, we plan to investigate the following issues in our future research:

- 1) Possibilities of adopting hybrid cryptography technique Diffie Hellman key exchange algorithm to further reduce the network overhead caused by digital signature;
- 2) examine the possibilities of adopting a key exchange mechanism to ensure a secure data authentication;
- 3) Testing the performance of EAACK in real network environment instead of software simulation.



5) CONCLUSION

Packet-dropping attack has always been a major threat to the security in MANETs. In this research paper, we have proposed a novel IDS named EAACK protocol specially designed for MANETs and compared it against other popular mechanisms in different scenarios through simulations. The results demonstrated positive performances against Watchdog, TWOACK, and AACK in the cases of receiver collision, limited transmission power, and false misbehavior report.

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