

Secured Multicast Routing Protocol for Wireless Sensor Networks

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Abstract: A Wireless Sensor Network (WSN) is a group of spatially dispersed sensor nodes which are interconnected by using wireless communication. A sensor node also called mote, is an electronic device which consists of a processor along with a storage unit, a transceiver module, a single sensor or multiple sensors, along with an Analog to Digital Converter (ADC) and a power source which normally is a battery. It may optionally include a positioning unit and/or a mobilization unit. Protecting the network from malicious attacks is an important and challenging issue in both wired and wireless networks and the issue becomes even more challenging in the case of wireless sensor networks. We would like to provide solution for the above problem using the dynamic strategy. Proposed solution to determination of the data correlation at each node by way of local computation and propose avoiding transmission of significantly similar data. This can lead to unused time slots at runtime (dynamic slack) which can be traded off for energy savings. The file list is displayed in both sender and the receiver but the file content is present in the sender only. The receiver request the file content by sending the file name then the sender verify the request if the receiver is authentic. Then sender splits the file content into packets and signs each packet by generating the key then encrypts the packets and sends to the receiver. The receiver verifies the packets and then decrypts the message using sender's public key.

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INTRODUCTION

User can send a data to destination and eliminating the packet trappers and modifiers in networks. The secure transmission is based on the following services. Includes system initialization, Directed acyclic graph, tree reshaping, node categorization, global ranking algorithm

System initialization: The purpose of system initialization is to set up secret pair wise keys between the sink and every regular sensor node. Preloading keys and other system parameters

Directed acyclic graph: In DAG establishment each sensor node randomly chooses the parent node from the

records. This module is used to send the data. First find the active peers in network. Among the active peers source will choose the destination node. Then source will find all possible paths to reach the destination. It also calculates the weight of all paths.

After analyzing the weight, the source will decide one path through which the packet will be send. If none of the possible paths found is less than threshold level, then it is the time to reset the threshold value else can't send the message.

Tree reshaping: Sensor node changes their parent node at a particular interval. This is called round. Each node in the selected path will just check the IP address in the data and decide whether are the intended user to receive the data or pass the data to the next node. Also, send an ACK to the source indicating that it receives the message sent by it.

Node categorization method: It is executed in the base station at each round. After executing the algorithm the sink calculates the dropping ratio for each node. The route has cost either smaller than or equal to the shortest single-path cost between two nodes includes the set of single-path routes between these nodes. Note that there may be multiple routes with equal minimal cost.

Global ranking method: Global ranking algorithm executed in the base station. After certain round is finished, this algorithm executed. It gets the certain round result from the node categorization algorithm. Whenever, a node receives the data packet it finds the source of the packet and sends an ACK message. The source gets the ACK from the nodes in the selected path confirming that the data is passing over the intended path. After getting the ACKs from all the nodes in the selected path, it will decide that the message is sent to receiver and shows a pictorial representation of the path.

ARCHITECTURE DIAGRAM

Architectural diagram of our proposed system as shown in Fig. 1.

Basic scheme: Our target is to find out both packet droppers and modifiers. In this scheme, a routing tree rooted at the sink is first established. When sensor data are transmitted along the tree structure toward the sink, each packet sender or forwarder adds a small number of extra bits which is called packet marks to the packet.

The format of the small packet marks is deliberately designed such that the sink can obtain very useful information from the marks. Specifically, based on the packet marks, the sink can figure out the dropping ratio associated with every sensor node and then runs our

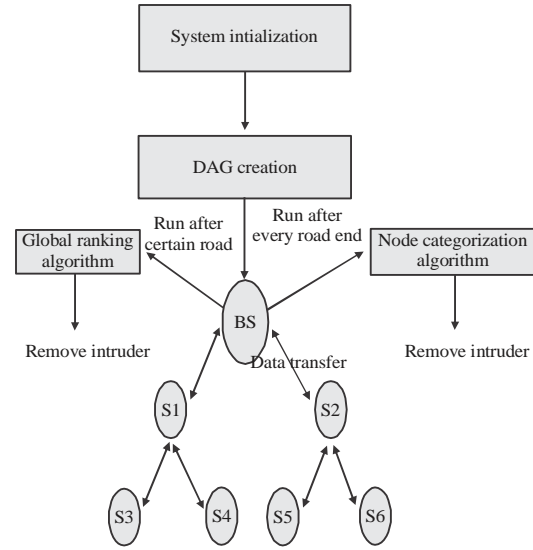


Fig. 1: Architecture diagram

proposed node categorization algorithm to identify nodes that are droppers/modifiers for sure or are suspicious droppers/ modifiers. As the tree structure dynamically changes every time interval, behaviors of sensor nodes can be observed in a large variety of scenarios.

As the information of node behaviors has been accumulated, the sink periodically runs our proposed heuristic ranking algorithms to identify most likely bad nodes from suspiciously bad nodes. This way, most of the bad nodes can be gradually identified with small false positive.

Using this concept the data can be safely send to the destination. Once the packet modifiers and trappers are identified that particular node is eliminated from networks. The duplication of data is eradicated so it consumes low energy levels.

Node categorization: Here, we propose a node categorization algorithm based on the nodes.

Algorithm: The node categorization consists of following steps:

1. Tree T with each node u and its Dropping ratio
2. For every sink node in T do
3. Find all the dropping ration
4. if $du < 0$ then
5. Set u as good or suspiciously node
6. If $du = 0$ then
7. Set u as good node
8. else if $du > 0$
9. Set u as bad
10. Else
11. Break
12. set u as surely bad
13. Repeat

If the dropping rate is <0 then the node has not dropped any packets otherwise nodes may dropped a packets assume to be a suspiciously node.

If the dropping rate is equal to 0 then the node has not dropped any packets. If the dropping rate is >0 then the node has suspected to be dropping any packets.

If the dropping rate is >0 then the node has suspected to be dropping any packets due to traffic, collisions and malicious node. Tree structure is dynamically changes in the regular interval of time.

Requirements to the sender: In our process the sender needs to add extra bit to each packet. Because it can provide a security level equivalent to conventional RSA and DSA with much shorter signature, the adding extra bit in operation is more efficient than the RSA signature generation. Moreover, this technique can be implemented over elliptic curves. It is used to achieve secure transmission of data at the receiver.

Enhanced scheme: The basic scheme targets at the packet loss problem, intruders and modifiers which is inherent in the internet and wireless networks. It has perfect resilience to packet loss no matter whether it is random loss or burst loss. In some circumstances, however, an attacker can inject forged packets into a batch of packets to disrupt the extra bits added to the each packet for verification, leading to Dos. A naive approach to defeat the Dos attack is to divide the batch into multiple smaller batches and perform batch verification over each smaller batch and this divide and conquer approach can be recursively carried out for each smaller batch which means contains extra bit for verifications at each receiver. In worst case the attacker can inject forged packets at very high frequency and expect that each receiver stops the batch operation and recovers the per packet signature verification which may not be viable at resource constrained receiver devices.

In this study, we present an enhanced scheme called global method which combines the basic scheme that packet filtering mechanism to tolerate packet injection in particular, the sender attaches each packet with a mark which is unique to the packet and cannot be spoofed. At each receiver, the multicast stream is classified into disjoint sets based on marks. Each set of packets comes from either the real sender or the attacker. The mark design ensures the packet from the real sender never falls into any set of packets from the attacker. Next each receiver only needs to perform Batch verify () over each set.

If the result is TRUE, the set of packets is authentic. If not, the set of packets is from the attacker and the receiver simply drops them and doesn't need to divide the

set into smaller subsets for further verification. Therefore, a strong resilience to Dos due to injected packets can be provided.

PERFORMANCE EVALUATION

We evaluate performance^[1-2] in terms of resilience to packet loss, efficiency and Dos resilience.

Resilience to packet loss: We use simulations to evaluate the resilience to packet loss and modifiers. The metric here is the verification rate, i.e., the ratio of number of authenticated packets to the number of received packets. Node categorization is a perfect resilience to packet loss and intruders because of its inherent design. While it is not designed for lossy channels, it can also achieve the perfect resilience to packet loss in lossy channels.

In the lossy channel model where no Dos attack is assumed to present, we can set the threshold $t = 1$ during transmission and thus each receiver can start batch verification as long as there is at least 1 packet received for each set of packets.

Efficiency: We consider latency, computation and communication overhead for efficiency evaluation under lossy channels and Dos channels.

Dos resilience: The signing and verification time is less. The signing is efficient. Therefore, we can save more computation resource at the sender. It can achieve more bandwidth efficiency by using node categorization. It can generate smaller key length.

RELATED WORKS

The approaches for detecting packet dropping attacks can be categorized as three classes: multipath forwarding approach, neighbor monitoring approach and acknowledgment approach. Multipath forwarding^[3,4] is a widely adopted countermeasure to mitigate packet droppers which is based on delivering redundant packets along multiple paths. Another approach is to exploit the monitoring mechanism. The watchdog method was originally proposed to mitigate routing misbehavior in mobile ad hoc networks^[5]. It is then adopted to identify packet droppers in wireless sensor network. When the watchdog mechanism is deployed, each node monitors its neighborhood collect the firsthand information on its neighbor nodes. A variety of reputation systems have been designed by exchanging each node's firsthand observations which are further used to quantify node's reputation. Based on the monitoring mechanism, the intrusion detection systems are proposed however, the watchdog method requires nodes to buffer the packets and operate in the promiscuous mode, the storage overhead and energy consumption may not be affordable for sensor

nodes. In addition, this on the bidirectional communication links; it may not be effective when directional antennas are used. Particularly, this approach cannot be applied when a node does not know the expected output of its next hop, since, the node has no way to find a match for buffered packets and overheard packets. Note that, this scenario is not rare, for example, the packets may be processed, and then encrypted by the next hop node in many applications that security is required. Since, the watchdog is a critical component of reputation systems, the limitations of the watchdog mechanism can also limit the reputation system. Besides, a reputation system itself may become the attacking target. It may either be vulnerable to bad mouthing attack or false praise attack. The third approach to deal with packet dropping attack is the multihop acknowledgment technique^[6]. By obtaining responses from intermediate nodes, alarms and detection of selective forwarding attacks can be conducted. To deal with packet modifiers, most of existing countermeasures are to modified messages within a certain number of hops, so that, energy will not be wasted to transmit modified messages. The effectiveness to detect malicious packet droppers and modifiers is limited without identifying them and excluding them from the network. Researchers hence have proposed schemes to localize and identify packet droppers, one approach is the acknowledgment-based scheme^[7,8] for identifying the problematic communication links. It can deterministically localize links of malicious nodes if every node reports ACK using onion report. However, this incurs large communication and storage overhead for sensor networks. The probabilistic ACK approaches are then proposed by Marti *et al.*^[5] and Ye *et al.*^[9] which seek tradeoffs among detection rate, communication overhead and storage overhead. However, these approaches assume the packet sources are trustable which may not be valid in sensor networks. As in sensor networks, base station typically is the only one we can trust. Furthermore, these schemes require setting up pair wise keys among regular sensor nodes, so as to verify the authenticity of ACK packets which may cause considerable overhead for key management in sensor networks^[10,11]. Ye *et al.*^[9] proposed a scheme called PNM for identifying packet modifiers probabilistically. However, the PNM scheme cannot be used together with the false packet filtering schemes. Because the filtering schemes will drop the modified packets which should be used by the PNM scheme as evidences to infer packet modifiers. This degrades the efficiency of deploying the PNM scheme.

CONCLUSION

In our research can effectively find out the intruders both packet droppers and packet modifiers than previous algorithms by using our effective node categorization and global ranking algorithms. Both algorithms runs in the base station and fully monitor the incoming packets

and provide the optimal path to the destination. In our work network structure is not static; it is changed at every round interval. The node categorization algorithm executes after every round finished and remove the bad nodes from the network based on the packet marks. And global ranking algorithm executes after certain round finished this algorithm takes the previous round result and then remove the suspiciously bad nodes from the network.

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