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ENHANCED PREDICTION OF VULNERABLE ATTACKS IN WIRELESS SENSOR NETWORK

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Abstract

Wireless Sensor Network (WSN) are gaining importance recent years due to its impact on cost, ability to cope up with node and communication failures, mobility, capability to withstand harsh environmental condition, monitoring purpose and ease of use. Despite Sensor nodes large collection of benefits there are few constrains such as security, Quality of Service and resource problems which act as hurdles in implementing sensor network application in real world environment. Security is considered to be a critical parameter in sensor network due to the fact that they are mostly deployed in an environment where human interaction is less. Since sensed data hold vital information integrity should be provided. An opponent or intruder is one who may perform various attacks on packets in order to make a node compromise and thereby cut shorting the communication to takes place. Attacks that have been concentrated here are packet dropping and modification. Sensor applications are time critical and if compromised nodes are not detected, large quantities of irrelevant data can be injected into the network which in turn will have a greater impact on computational cost and storage overhead. In this proposed technique energy consumption and delay aspects are considered and experimented with Enhanced Node Categorization and Heuristic Ranking (ENCHR) algorithm. ENCHR is used to identify compromised nodes and further a Secure Routing and Encryption techniques (SRE) are provided. This proposed scheme overcomes security and energy constrains, thereby providing a reliable communication to take place.

Keywords: Wireless Sensor Network, Packet Droppers, Packet Modifiers, Message Authentication Code, Compromised nodes, Routing.

1. Introduction

Wireless Sensor networks consist of large number of small sensor nodes having few constrains such as physical resource, limited computation capacity, restricted memory space and security. Sensor nodes are suitable with an on-board processor. Instead of sending the raw data to the nodes responsible for the fusion, they use their processing abilities to locally carry out simple computations and transmit the processed data. A WSN consist of tiny devices which can monitor physical or environmental conditions such as temperature, sound, pressure, motion or pollutants etc. based on their area of interest and in turn produces data. These sensed data are further forwarded to the sink (gateway, base station, and user). A sensor network is often deployed in an environment where human interaction is less to perform the monitoring and data collection tasks. Deploying in such an environment may result in lack of physical protection and leads to node compromising. Once nodes are compromised in WSN an opponent may come up with several attacks which

are passive or active in nature to disrupt the communication. This paper deals with packets dropping and modifying packets which are common attacks that may be aroused by an opponent.

In this paper, a modified and effective technique is proposed to catch both packet droppers and modifiers. In which initially a routing tree is rooted at the sink. The sensed data are transmitted through the tree structure toward the sink along with additional parameters (marks) with the packets. The additional information is designed in such a way that the sink can obtain very useful information from the marks. Based on the received additional information, the sink can examine the dropping ratio with respect to the corresponding or every sensor node. Every participating node computes two MACs (Message Authentication Code) over the event, one using its key shared with the BS, and the other using its pair wise key shared with its upper associated node. The node transmits the packet along with the MAC value produced and the forwarding node verifies the data integrity. Then the sink runs 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, behaviours of sensor nodes can be observed in large variety of scenarios. Finally, as the information of node behaviours has been accumulated, the sink periodically runs the heuristic ranking algorithms to identify most likely bad nodes with small false positive. After finding out the compromised node secured routing path is found. A route request is broadcasted to all nodes which consist of a record listing the addressing of the intermediate nodes excluding the compromised nodes identified. Later shortest path is identified and data is transferred. The proposed scheme is effective in identifying both packet droppers and modifiers with low communication and energy overheads and being compatible with existing false packet filtering schemes, that can be deployed together with existing false packet filtering schemes is detected. In the rest of the paper, section 2 deals with related work. Section 3 introduces our proposed system model. The performance of the proposed technique is evaluated in Section 4 and finally Section 5 emphasis the conclusion.

2. RELATED WORKS:

There are several approaches made for detection of vulnerable attacks. Packet dropping schemes are concentrated in [2][3][4][5][6]. Detection of packet dropping attacks for WSN proposes a solution to identify paths that drop packets by using alternate paths, but it succeeds only when the alternate path does not have any malicious nodes [2]. In this scheme single path data forwarding is employed and later it is convertor in multipath data forwarding [3]. Routing process and neighbour monitoring mechanisms are explained in [4][5][6]. Packet modification are considered in [7][8][9]. In SEF (Statistical Enroute filtering scheme detects and filters out false reports based on probabilistic key distribution [7]. Location Based Resilient security to filter out packets are proposed in [10], but in spite of all filtering techniques intruders are able to move on and communication overhead is increased. Probabilistic Nested marking is proposed to locate vulnerable nodes and it does so within the framework of packet marking, but the evidence to find packet modifiers are also filtered out. In other paper extensions to Dynamic Source Routing are given such as watchdog and path rater [11]. Watchdog identifies misbehaving nodes and path rather helps routing protocols avoid those nodes. In paper [12] CHEMAS is Check point based multi hop acknowledge Scheme which is used identify selective forwarding attacks based on pre-selected criteria. Security attacks such as eavesdropping and Denial of Services are elaborated in [13].

A survey of various passive and active attacks and their challenges in wireless Sensor Network are discussed [14]. In this paper [15] only denial of service attack is discussed with acknowledgement based mechanism. Similar to paper [12] selective forwarding attacks are concentrated in [16] with small modification made where the base station as well as the node can detect attackers. Routing misbehaving by nodes are dealt with acknowledgement based mechanism [17]. An overall space is categorized into several parts and depending on the design space packet droppers are detected in [18]. In paper [19] FL-PQM scheme which focuses on Failure Localization path quality monitoring. Monitoring mechanism if followed in [20] where the neighbour nodes are monitored and attacks such as black hole is focused.

3. SYSTEM MODEL

System model is concentrated with selection of architecture elements their interaction and constrains to provide a framework. System model also specifies the components, connections, techniques, technologies and other functional and non-functional requirements.

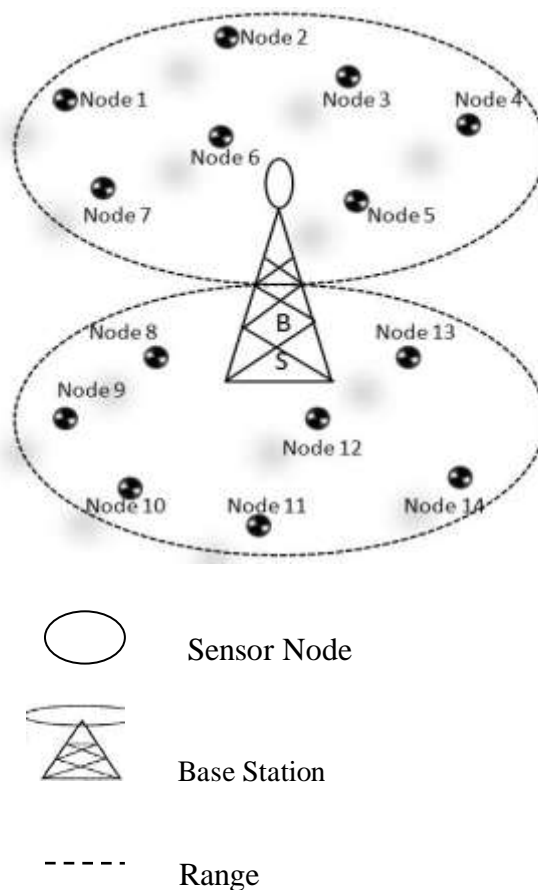


Fig. 1 System Model

3.1 Node Configuration

Deployment phase is considered in node configuration which is further classified into Initialization and Transmission phase.

3.1.1 Initialization Phase

In Initialization phase, sensor nodes are deployed in such a way that it is a Directed Acyclic Graph and from that a routing tree is derived. The routing tree keeps on changing and routing behavior is gathered by the sink. Each node is pre-loaded with a unique id (sequence number) as well as necessary keying materials which include secret key, duration to establish pair wise key with other nodes.

3.1.2. Transmission Phase

In transmission phase, packets from the sensor nodes are transmitted through the routing tree. Every node computes two MAC, one using the key shared with the Base Station (BS) and the other using pair wise key that is shared. The node transmits the packet along with the MAC value produced and the forwarding node verifies the data integrity and after verifying the associated MAC value is removed and the corresponding nodes MAC is included and forwarded to the sink. Base Station also verifies data integrity.

3.2 Compromised Nodes Identification Phase

The routing tree is reshaped and compromised nodes are identified using ENHCH. In ENHCH scheme packet droppers or modifiers are found by clustering the nodes depending on the risk factor and dropping ratio as good, moderate or bad. After finding, the nodes are further ranked to identify most nodes that are sure to drop packets.

3.2.1 Ranking Technique

A routing table is maintained and an accused account is maintained in which nodes are ranked depending on their identification to be bad for several times. The most accused value node is fixed to be bad for sure. The accused value of nodes is reduced by the number of times it has been found together along with the bad node.

3.3 Secure Routing Process

After identifying the compromised nodes a secure route is provided for data transmission. Route is initially discovered and later the founded route is maintained.

3.3.1 Route Discovery and Maintenance

To initiate the Route Discovery, node transmits a "Route Request" as a single local broadcast packet to all the node that have been registered with the base station and also the nodes that are present in the transmitting path. Each Route Request identifies the source and the destination of the Route Discovery, and also contains a unique id. Each Route Request also contains a record listing the address of each intermediate node excluding the compromised that has been identified earlier through which this particular copy of the Route Request has been forwarded.

4. PERFORMANCE EVALUATIONS

Our proposed scheme is experimented using Network simulator (NS 2). The performance is measured with metrics: Residual energy, Detection rate and Delay. An additional aspect such as false positive probability is included in our evaluation. For evaluation purpose 30 to 50 sensor nodes are deployed randomly and routing table consists of source, destination and intermediate node with residual energy, hop count and other aspects is created and updated periodically. Initially packets are transferred and nodes that are compromised are identified using our proposed scheme, later a secure routing is provided which allows packets not to transmit through the compromised nodes.

TABLE I. ROUTING TABLE

SN	DN	IN	HC	RE	B
0	4	1-2-3	3	99.50	256
5	9	6-8	2	99.49	256
10	15	6-11-12-14	4	99.47	250
19	25	22-23	2	99.45	250

SN - Source Node
 DN - Destination Node
 IN - Intermediate Node
 HC - Hop Count
 RE - Residual Energy
 B - Buffer

5. CONCLUSION

In this paper, a simple technique is introduced to identify both packet droppers and modifiers. Packets are transmitted through routing tree along with the MAC values and data integrity is checked by nodes and the sink. The routing is performed to identify the shortest path between each source node and their destination and residual energy is calculated for each node in the network. The routing table is created and updated periodically. The packet will be transmitted through the shortest path. Packet dropping ratio, delay and energy calculations are made to identify the compromised nodes.

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A Brief Author Biography

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