

2. Related Works

The location privacy protection most growing and hot researching topic in wireless sensor network. Most of the existing schemes are mention only the source side of the location privacy or sink side of the location privacy independently. The major disadvantage is none of them consider the location privacy of both source and sink simultaneously. Such that in recent years, the research are focuses on the field of end to end location privacy against local adversary in WSNs.

In that the most popular end to end location privacy schemes are (1) Lukewarm potato model, (2). Duplex privacy scheme, (3) Secure location protection using fake nodes, (4) Base station location anonymity and security technique.

Such that four recent end to end location privacy protection schemes are focusing the safety period, to measure the safety period is started from the moment of adversary until the adversary will find out the original node of the data in source side. The second stage is monitoring the end to end latency between the average time take from source to sink and the final stage is defined the energy consumption it shows the communication between the source to sink in equal amount of energy.

The first model of the end to end location privacy scheme **lukewarm potato model** which is defines as, randomly choosing the nearby node to deviate the adversary. If the monitoring packets are delivery form source to sink in same and fixed path means than the eavesdropper can easily hack and identify the location of the entire path of the source and sink via node by node counting.

To avoid this problem the lukewarm potato model is used to achieve the end to end location privacy protection by choosing the randomizing the delivery path. In LPM have a three major list to choosing the nearby node that is closer list, equivalent list and further list.

The list that contains the hop count H_i and node N_i . In that the closer lists handle the each node in N_i with a smaller than hop count H_i denoted in closer list. The equivalent list is defines the each node in N_i with the equal count to the H_i and each node in N_i with a hop count larger than H_i will be included into further list.

In lukewarm potato list contains the union of closer list and equivalent list. The initialization step is to check $next_hop = null$. If the hop count is null than lukewarm potato list was created. While receive the message than randomly choose a nearby node from LPL to the next hop and forward the received packet to the next hop. Since this model is increase the end to end latency and safety period is dose not high.

The second end to end location privacy model is **Duplex privacy scheme** which is defines as, creating the dummy message and backtrack to original message for Deviate the adversary. Such that, real messages travel along the shortest route from the source to the sink node and branches are designed along the shortest route. Then the Source side travel dummy messages from leaf nodes which make to

deviate adversary. The each branch are generating Dummy message to back track the original message travel from source to destination. Those all the process is done when local adversary involved during the time of data transmission from source to destination.

If suppose the destination node got the dummy message means it destroy the whole delivery path and again choose the new nearest path from source to destination for data transformation. In that each original data node having the same fixed packet size. Based on that the destination node can easily find out the original node and dummy node. Here the problem and major disadvantage is smart hacker can easily hack and find out the original data node during the communication between source to sink and also the tree branch are created in both source and sink side for that the time latency is very high and energy capacity is very low.

The third model of end to end location privacy protection is **secure location protection using fake nodes**. In this scheme we can create and deploy the dummy nodes for both source and sink tree branch. The dummy nodes only pass the dummy message from source to destination based on the dummy node we can able to easily deviate adversary by integrated to the original node.

If any adversary is backtrack to the original data than the dummy node from child branches will be integrated to the original node and pass through the destination path. The path of the data transformation must be selected in random once or dynamic once.

If the sink node got the dummy message than it will reselect a child node to relay this dummy message. And this model we are deployed own dummy nodes such that the life time of the nodes energy is very poor and also the end to end latency is high.

The fourth and another end to end location privacy protection scheme is **Base station location anonymity and security technique**. In this model we create the proxy source and proxy sink to make the real messages be delivered random path. Here the process is from the source to the proxy source, from the proxy source to the proxy sink and from the proxy sink to the sink.

The source only chooses the proxy source based upon the shortest path and the proxy source cannot be choosing the nearby sink of the proxy sink. If the proxy source or proxy sink capture the adversary then the whole delivery path will be blocked and it choose another nearby pat for sending the data from source to destination.

Here also we can create the dummy nodes in both sides of tree branches for passing the dummy message to deviate the adversary. The main drawback for this model is implementation of proxy in source and sinks side. If we want to provide high location privacy in large area then it is very difficult.

3. Proposed Method

In this paper, we propose a novel tree diversionary protection scheme for protecting location privacy based on

hiding and seeking the strategy to create diversionary or decoy routes along the path to the sink from the original source at the end of the each diversity path to be discarded, which periodically release the dummy message. We also focusing to maximum the network lifetime and reduces the energy consumption with the high safety period. As well as we can create the redundant diversity path in non hotspot regions with abundant energy. The proposed scheme must be satisfied the following method: (1) the routing trees established are homogeneous and adversary cannot infer the source location based on the shape of the tree and the historical trajectory of the routing path. (2) The node must be contain energy consumption in hotspots that is not increased and the network lifetime is not decreased (3) The abundant energy in the region away from the sink is utilized to build redundancy diversionary routes, so that it is difficult for the adversary to trace to original data node.

The implementation of TDP is divided into two design method: (1) establish the backbone route path direct to the network edge based on the existing original data routes, and improve the historical trajectory in order to avoid direction-oriented attacks by implementing homogeneous trees. (2) Establish redundancy diversionary routes as many as possible in regions with abundant energy to satisfied the energy consumption and network lifetime

The main idea is that we establish the original node away from the source node and then establish tree branch path towards the sink with strategically created diversionary routes as its branches, and also we can create the diversionary routes. The ends of these diversionary routes are dummy source nodes to be decoy.

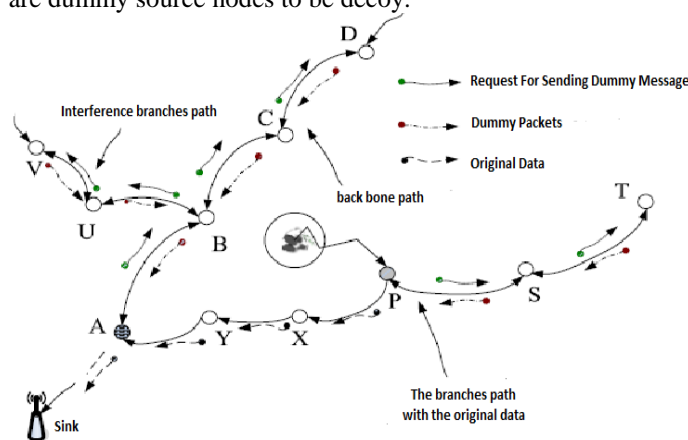


Fig 1 .Establish the process of TDP

Previous research has shown that, attacker can still trace to the source node with a relatively high possibility. Therefore, one possible solution is to make it difficult for attacker to trace to the original node, so that will be impossible to trace the source node. The TDP first establishes a backbone path direct to the network border with diversionary routes as its branches. Then, it establishes diversionary routes as many as possible with each diversionary route directing to the network border, forming a tree based routing path. The data packet length and the data generating possibility are the same in each diversionary route

4. Algorithm for TDP

Tree-Based Diversionary protection:

Based upon the network model the tree based diversionary protection schemes include three important stages that is (1) Tree-based diversionary routing establishment; (2) Stable operation stage of the tree-based routing path, (3) Destruction of tree-based diversionary routing.

Establish Tree-based diversionary route with original node. First, establish the branch with original node, and then establish the tree trunk and other branches. Generally, original node cannot be the node on the backbone routing path, because the backbone route is relatively easy to identify, and therefore the original node is more vulnerable to be find out. If the original node is not on the backbone path, it can be on any existing branches; therefore it is difficult for adversaries to trace. The establishing process of branch with original node is as the following two directions.

In left-down direction the original node P selects node X from its neighbor nodes, which is the node closest to the sink and on the left of P according to the left-hand rule. Then, X selects node Y which is on the most right of X and with the same hops as X to the sink according to the left-hand rule, then selects the most left node closest to the sink, i. e., alternately selects the node closest to the sink and the node with same hops, until the transmission distance reaches the hops \emptyset namely, node A we call it the intermediate node.

The upper right direction of original node P. P sends request packet containing information of "request sending dummy packets" to the most right node S, and the sending frequency of dummy packets is included in the request packet, which indicates node S should send dummy data packets to P in the fixed time. Similarly node S sends request packet to node T, then T get the request and sends dummy packets to S, and so on, until reaching the network border, then the branch route with original node is established.

Creating Tree

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1: create original node P use the same algorithm as reference [6]
2:  $\sigma = \text{random}(0,1)$ 
3: If  $\sigma \geq \frac{1}{2} + \frac{1}{h}$  then  $\mathcal{G} = \text{"right"}$  Else  $\mathcal{G} = \text{"left"}$ 
4: P(claim)  $\leftarrow \langle \text{ID}_p, \text{type}, \Phi, \text{branch\_loactions}, \tau, \mathcal{G}, \text{padding\_data} \rangle$ 
5: P(sign_claim)  $\leftarrow k_p^x \langle \text{ID}_p, \text{type}, \Phi, \text{branch\_loactions}, \tau, \mathcal{G}, \text{padding\_data} \rangle$ 
6: next_node = P
6.1: while (next_node(sign_claim).  $\Phi > 0$ )
    Alternately select the next_node as the next hop based on
    the following two strategies
    next_node = GetNextOnLeastHop(current_location,  $\mathcal{G}$ );
    next_node = GetNextOnEqualPath(current_location,  $\mathcal{G}$ );
     $\Phi = \Phi - 1$ 
    End
6.2: A = next_node
6.3: next_node = P
6.4: while (next_node has not reached network border)
    Alternately select the following next_node as the next hop
    next_node = GetNextOnMaxHop(current_location,  $\mathcal{G}$ );
    next_node = GetNextOnEqualPath(current_location,  $\mathcal{G}$ );
    End
7: for node A respectively runs 7.1 and 7.2
    7.1: while (GetNodeOnMinHop(A) is not sink)
        A = GetNextOnMinHop(A)
    End
    7.2 while (GetNextOnMaxHop(A) not reach network border)
        A = GetNextOnMaxHop(A)
    End
    End
8: for each node B in the backbone route
    If B.hop is in branch_loactions
        next_node = B
        while (next_node have not reach network border)
            Alternately select the following next_node as the next hop
            next_node = GetNextOnMaxHop(current_location,  $\mathcal{G}$ );
            next_node = GetNextOnEqualPath(current_location,  $\mathcal{G}$ );
        End while
    End if
End for

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Creating Branches Routing

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9: for each node C on the tree route
    when the fixed time  $\tau$  comes, do the following
        if C receives the real data packet
            Send the real data packet to GetNextOnMinHop(C);
        else
            Send dummy packets to GetNextOnMinHop(C);
        End if
    End for
Eliminate Branches connection if the adversary is available
10: If a node receives a "stop" packets
    Send packets to all neighbors in the tree route
    Stop transmitting any packets
End if

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Stable Operation Stage of TDP:

In the Stable Operation Stage of TDP, If the original data packet is received, then the node sends the real data packet when it comes to the transmission time, if not, dummy

message is generated in a specific time and sent when it comes to the transmission time.

Destruction of Tree-Based Diversionary:

The destruction of tree route is relatively simple, which depends on the original node P, and intermediate node A. If node P and node A have not received the original data packets within the time out interval, this routing path will be discarded. Node P and node A will send message to nodes involved in the route to discard once all the path get the stop information, they will no longer send any message. Thus, the entire route stops sending message.

Establish the backbone path from sink to source:

In this part, we will discuss the location of the backbone path from sink to source to achieve security. With original path of strategy there is only one original path, which is the shortest path from phantom node to the sink, so the route path depends on the original node.

We identify a novel attack method called direction-oriented attack, which has good attack performance and can effectively attack the privacy preserving strategies based on original node routing path, and it shows that there is still potential security hazard by randomly selecting original node. Therefore, in this work, we propose a new strategy to avoid direction-oriented attack in tree based diversionary routing.

5. Conclusion

The end to end location privacy is most important issues in WSN. In this paper we discuss about previous four end to end location privacy schemes and its drawback regards safety period, energy computation and latency. To overcome this problem we proposed one new scheme is called Tree Diversionary protection schemes. In that scheme we achieve and overcome the previous problem. As well as we can consider about the direction based attack to avoid and deviate the internal adversary. Finally we discuss in this capture about the backbone routing path, original node travelling path, dummy nodes placed in the TDP for providing the location privacy to achieve safety, energy and latency.

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