Improving Security and energy efficiency in Ring clustered WSN

Pooja Tekade, Prof. Nutan Dhande

Department of Computer Science and Engineering ACE Nagthana Wardha Maharashtra, India

ABSTRACT

Wireless sensor networks (WSNs) are increasingly used in many applications, such as volcano and fire monitoring, urban sensing, and perimeter surveillance. In a large WSN, in-network data aggregation (i.e., combining partial results at intermediate nodes during message routing) significantly reduces the amount of communication overhead and energy consumption. The research community proposed a loss-resilient aggregation framework called synopsis diffusion, which uses duplicate insensitive algorithms on top of multipath routing schemes to accurately compute aggregates (e.g., predicate count or sum). However, this aggregation framework does not address the problem of false sub-aggregate values contributed by compromised nodes. This attack may cause large errors in the aggregate computed at the base station, which is the root node in the aggregation hierarchy. In this paper, we make the synopsis diffusion approach secure against the above attack launched by compromised nodes. In particular, we present an algorithm to enable the base station to securely compute predicate count or sum even in the presence of such an attack. Our attack-resilient computation algorithm computes the true aggregate by filtering out the contributions of compromised nodes in the aggregation hierarchy. Extensive analysis and simulation study show that our algorithm outperforms other existing approaches.

Keywords: WSN, Data Aggregation, Attack Resilient

I. INTRODUCTION

A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling control of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. The topology of the

WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique between the hops of the network can be routing or flooding.

II. PROPOSED METHODOLOGY

Setting up Network Model

We consider a large-scale, homogeneous sensor network consisting of resource-constrained sensor nodes. Analogous to previous distributed detection approaches; we assume that an identity-based public-key cryptography facility is available in the sensor network. Prior to deployment, each legitimate node is allocated a unique ID and a corresponding private key by a trusted third party. The public key of a node is its ID, which is the essence of an identity-based cryptosystem. Consequently, no node can lie to others about its identity. Moreover, anyone is able to verify messages signed by a node using the identity-

based key. Such network architecture is consistent with the design of storage centric sensor networks.

Falsifying the local value:

A compromised node C can falsify its own sensor reading with the goal of influencing the aggregate value. We assume that if a node is compromised, all the information it holds will be compromised. We conservatively consider that all malicious nodes can collude or can be under the control of a single attacker. We use a Byzantine fault model, where the adversary can inject any message through the compromised nodes. Compromised nodes may behave in arbitrarily malicious ways, which means that the sub-aggregate of a compromised node can be arbitrarily generated. However, we assume that the attacker does not launch DoS attacks, e.g., the multi-hop flooding attacks with the goal of making the whole system unavailable
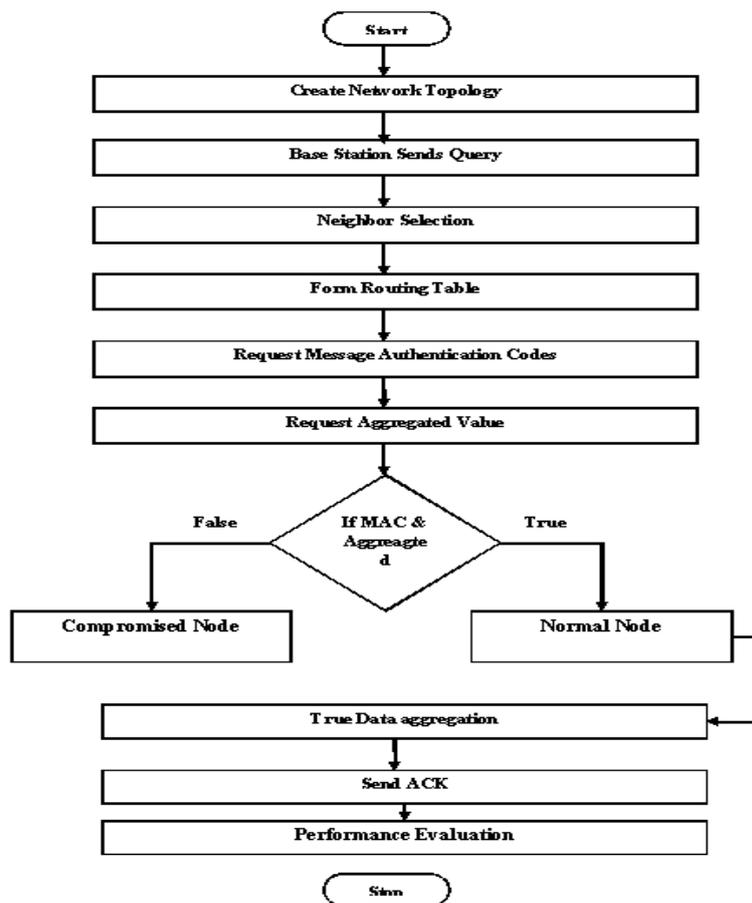
Figure 1

Computing Sum Despite Attacks:

In this module, we develop an attack-resilient protocol which enables BS to compute the aggregate despite the presence of the attack. We observe that, in general, BS can verify the final synopsis if it receives one valid MAC for each '1' bit in the synopsis. In fact, to verify a particular '1' bit, say bit i ,

BS does not need to receive authentication messages from all of the nodes which contribute to bit i . As an example, more than half of the nodes are likely to contribute to the leftmost bit of the synopsis, while to verify this bit, BS needs to receive a MAC only from one of these nodes.

Simulation Output
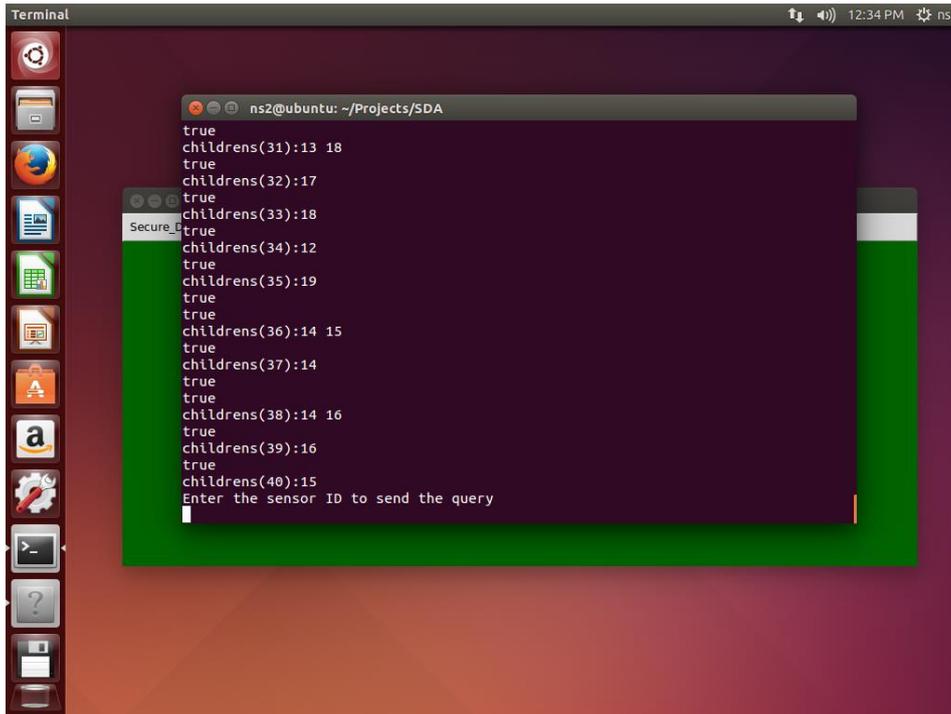
Figure 2. Sender Selection
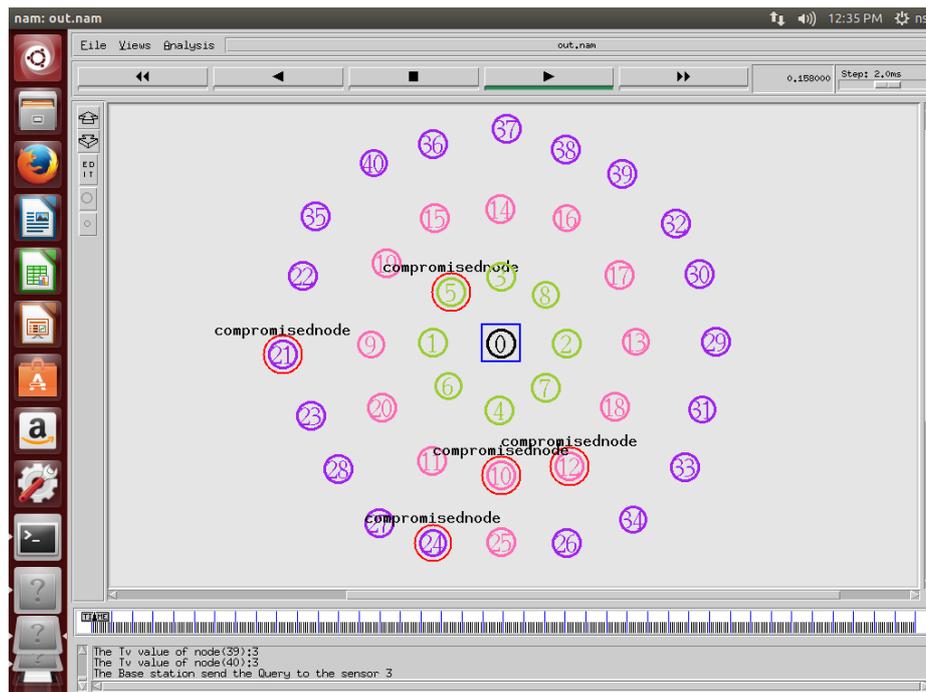
Figure 3. Ring Based MANET with clustering

Figure 4. Initiating Data Transfer

Figure 5. Sending Data from one cluster to another
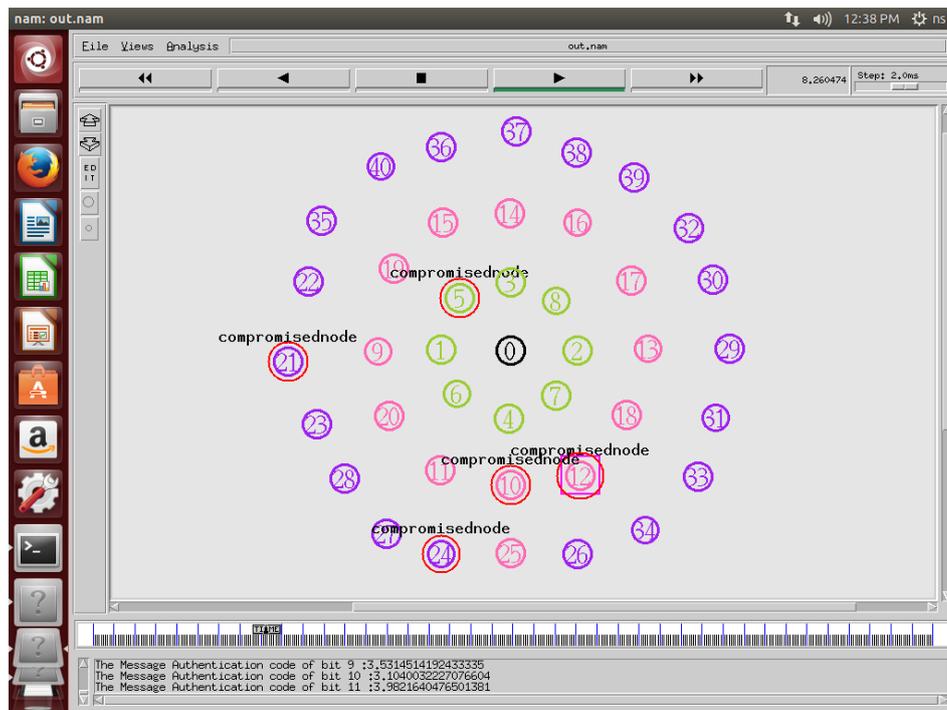
Figure 6. MAC Authentication for Checking Compromised Node

III. CONCLUSION

We discussed the security issues of in-network aggregation algorithms to compute aggregates such as predicate Count and Sum. In particular, we showed the falsified sub-aggregate attack launched by a few compromised nodes can inject arbitrary amount of error in the base station's estimate of the aggregate. We presented an attack-resilient computation algorithm which would guarantee the successful computation of the aggregate even in the presence of the attack.

IV. REFERENCES

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