A Survey on Problems Faced in Identification of Malicious Data Insertion in Wireless Sensor Networks and Rectification of It

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Abstract: The purpose of this survey is to present overview of approaches to detecting malicious data injections in wireless sensor network. It also discusses the advantages and disadvantages of different detection methods and compare different approaches them. Wireless sensor networks (WSNs) are defenseless and can be maliciously traded off, either physically or remotely, with potentially devastating impacts. At the point when sensor systems are utilized to recognize the occurrence of events, for example, fires, intruders, or heart attacks, malicious data can be injected to create fake events, and along these lines trigger an undesired reaction, or to cover the occurrence of actual events. Therefore there is a need to identify malicious data injections and build measurement estimates that are resistant to several compromised sensors even when they collude in the attack either willingly or under duress.

Keywords: Malicious Data Injection, Detection, Wireless Sensor Network, Mining and statistical methods, security management, ad hoc and sensor networks.

1. Introduction

Wireless Sensor Networks (WSNs) can give effective also, financially viable solutions for a substantial assortment of applications, for example, health monitoring, scientific data gathering, environmental monitoring, and military operations. Then again, sensor nodes in these applications could be effortlessly traded off and can inject self-assertively distorted qualities into the networks.

WSNs are regularly used to detect events occurring in the physical space across diverse applications, for example, military surveillance, wellbeing, and environment (e.g., volcano) monitoring. In spite of the fact that these applications have diverse tasks, they all gather sensor measurements and interpret them to identify events, i.e., specific states of interest followed by a remedial response. Such reaction may have significant outcomes and expense. In this manner, the estimations driving to the event detection turn into a basic asset to secure.

When the estimations are somehow replaced or modified by an attacker, they manage malicious data injections. The attacker may make utilization of the injected data to evoke an occasion reaction, for example, departure on account of flame, when no occasion has happened, or veil the event of a genuine occasion, for example, the trigger for an intrusion alert. Diverse means for acquiring control over the estimations are conceivable. A large number of the studies in the literature address physical and network layer threats by securing the integrity of the measurements amid their transmission (e.g., with a cryptographic hash function). However attacks may trade off the estimations even some time recently they are transmitted. For instance, an attacker may alter with a sensor in the field and load software that reports false estimations. Another probability is that the attacker controls environment by utilizing for case a lighter to trigger a fire alarm.

2. Literature Survey

D. Zhang and D. Liu [1] present a software confirmation plan for dynamic data integrity based on data boundary integrity. It automatically transforms the source code and embeds data guards to track runtime program information. A data guard is unrecoverable once it is corrupted by an attacker, regardless of the possibility that the attacker fully controls the framework later. The corruption of any data guard at runtime can be remotely identified. A corruption either demonstrates a software attack or a bug in the software that needs immediate attention. The advantages of the proposed confirmation plan are as per the following. In the first place, it doesn't depend on any extra hardware support, making it suitable for low cost sensor nodes. Second, it presents minimal communication cost and has adjustable runtime memory overhead. Third, it works even if sensor nodes use different hardware platforms, as long as they run the same software.

B. Sun, X. Shan, K. Wu, and Y. Xiao [2], they first propose integration of framework monitoring modules and intrusion detection modules in the context of WSNs. They propose an Extended Kalman Filter (EKF) based mechanism to recognize false injected data. In particular, by monitoring behaviors of its neighbors and utilizing EKF to predict their future states (genuine in-network aggregated values), every node goes for setting up a normal range of the neighbors' future transmitted aggregated values. This task is challenging due to conceivably high packet loss rate, harsh environment, sensing uncertainty, and so forth. They outline how to use EKF to address this challenge to make effective local detection mechanisms. Utilizing distinctive
aggregation functions (average, sum, max, and min), they
display how to get a theoretical threshold. They further
apply an algorithm of combining Cumulative Summation
(CUSUM) and Generalized Likelihood Ratio (GLR) to
increase detection sensitivity.

Y. Liu, P. Ning, and M. K. Reiter [3], present a new
class of attacks, called false data injection attacks, against
state estimation in electric power matrices. They
demonstrate that an attacker can misuse the configuration of
a power framework to launch such attacks to effectively
introduce arbitrary errors into certain state variables while
bypassing existing methods for terrible measurement
recognition. In addition, they look at two reasonable attack
situations, in which the attacker is either compelled to some
specific meters (because of the physical security of the
meters), on the other hand restricted in the assets required to
compromise meters. They demonstrate that the attacker can
systematically and proficiently construct attack vectors in
both situations, which cannot just change the results of state
estimation, additionally modify the outcomes in arbitrary
ways. Even though these work carried out in electric power
grid they have made a point which is more relevant in the
case wireless sensor networks (WSNs) & hence a proper
treatment of the same is essential.

F. Bao, I.-R. Chen, M. Chang, and J.-H. Cho [4] propose a
highly adaptable cluster-based hierarchal trust
management protocol for wireless sensor networks (WSNs)
to adequately manage selfish or malicious nodes. Unlike
prior work, they consider multidimensional trust attributes
determined from communication and social networks to
assess the overall trust of a sensor node. By method for a
novel probability model, they describe a heterogeneous
WSN containing an extensive number of sensor nodes with
immeasurable distinctive social and quality of service (QoS)
behaviors with the goal to yield “ground truth” node status.
This serves as a premise for accepting their protocol design
by comparing at subjective trust created as a result of
protocol execution at runtime against objective trust
acquired from actual node status.

Y. Zhang et al [5] accurate analysis and decision-making
relies on the quality of WSN data as well as on the
additional information and context. Raw observations
collected from sensor nodes, however, may have low data
quality and reliability due to limited WSN resources and
harsh deployment environments. This article addresses the
quality of WSN data focusing on outlier detection. These are
defined as observations that do not conform to the expected
behavior of the data. The developed methodology is based
on time-series analysis and geostatistics.

M. Mathews, M. Song, S. Shetty, and R. McKenzie[6] While wireless sensor networks are proving to be a versatile
tool, many of the applications in which they are
implemented have sensitive data. In other words, security is
crucial in many of these applications. Once a sensor node
has been compromised, the security of the network degrades
quickly if there are not measures taken to deal with this
event. There have been many approaches researched to
tackle the issue. In this paper, we look into an anomaly-
based intrusion detection system to detect compromised
nodes in wireless sensor networks. An algorithm to detect
the compromised sensor nodes has been developed.

A. Liu and P. Ning[7] present the design, implementation,
and evaluation of Tiny ECC, a configurable library for ECC
operations in wireless sensor networks. The primary
objective of Tiny ECC is to provide a ready-to-use, publicly
available software package for ECC-based PKC operations
that can be flexibly configured and integrated into sensor
network applications. TinyECC provides a number of
optimization switches, which can turn specific optimizations
on or off based on developers’ needs.

O. Salem, Y. Liu, A. Mehaoua, and R. Boutaba[8], we
propose a lightweight approach for online detection of faulty
measurements by analyzing the data collected from medical
wireless body area networks. The proposed framework
performs sequential data analysis using a smart phone as a
base station, and takes into account the constrained
resources of the smart phone, such as processing power and
storage capacity. The main objective is to raise alarms only
when patients enter in an emergency situation, and to discard
false alarms triggered by faulty measurements or ill-behaved
sensors. The proposed approach is based on the Haar
wavelet decomposition, non-seasonal Holt–Winters
forecasting, and the Hampel filter for spatial analysis, and on
for temporal analysis. Our objective is to reduce false alarms
resulting from unreliable measurements and to reduce
unnecessary healthcare intervention.

A. Seshadri, M. Lük, A. Perrig, L. van Doorn, and P.
Khosla[9] present SCUBA (Secure Code Update By
Attestation), for detecting and recovering compromised
nodes in sensor networks. The SCUBA protocol enables the
design of a sensor network that can detect compromised
nodes without false negatives, and either repair them
through code updates, or revoke the compromised nodes.
The SCUBA protocol represents a promising approach for
designing secure sensor networks by proposing a first
approach for automatic recovery of compromised sensor
nodes. The SCUBA protocol is based on ICE (Indisputable
Code Execution), a primitive we introduce to dynamically
establish a trusted code base on a remote, untrusted sensor
node.

F. Liu, X. Cheng, and D. Chen [10] though destructive to
network functions, insider attackers are not detectable with
only the classic cryptography based techniques. Many
mission-critic sensor network applications demand an
effective, light, flexible algorithm for internal adversary
identification with only localized information available. The
insider attacker detection scheme proposed in this paper
meets all the requirements by exploring the spatial
correlation existent among the networking behaviors of
sensors in close proximity. Our work is exploratory in that
the proposed algorithm considers multiple attributes
simultaneously in node behavior evaluation, with no
requirement on a prior knowledge about normal/malicious
sensor activities. Moreover, it is application friendly, which
employs original measurements from sensors and can be
employed to monitor many aspects of sensor networking
behaviors.
3. Conclusion

This paper surveys on different approaches to detecting malicious data injections in wireless sensor network. It also discusses the advantages and disadvantages of some of the previous detection methods and compares them. The focus is on detecting malicious data injections in event detection WSNs, in particular when collusion between compromised sensors occurs either willingly or under duress. We find it essential more so now to have an algorithm that can be customized and be used in different applications, and for different kinds of events. This survey throws light on the necessity to devise and develop a working solution under these circumstances.

References

[1] D. Zhang and D. Liu, “DataGuard: Dynamic data attestation in wireless sensor networks,” in Proc. IEEE/IFIP Int. Conf. DSN, 2010, pp. 261–270.
[2] B. Sun, X. Shan, K. Wu, and Y. Xiao, “Anomaly detection based secure-in-network aggregation for wireless sensor networks,” Syst. J., vol. 7, no. 1, pp. 13–25, Mar. 2013.
[3] Y. Liu, P. Ning, and M. K. Reiter, “False data injection attacks against state estimation in electric power grids,” Trans. Inf. Syst. Secur., vol. 14, no. 1, pp. 21–32, May 2011.
[4] F. Bao, I.-R. Chen, M. Chang, and J.-H. Cho, “Hierarchical trust management for wireless sensor networks and its applications to trust-based routing and intrusion detection,” IEEE Trans. Netw. Service Manage., vol. 9, no. 2, pp. 169–183, 2012.
[5] Y. Zhang et al., “Statistics-based outlier detection for wireless sensor networks,” Int. J. Geogr. Inf. Sci., vol. 26, no. 8, pp. 1373-1392, 2012.
[6] M. Mathews, M. Song, S. Shetty, and R. McKenzie, “Detecting compromised nodes in wireless sensor networks,” in Proc. SNPD, 2007, vol. 1, pp. 273–278.
[7] A. Liu and P. Ning, “TinyECC: A configurable library for elliptic curve cryptography in wireless sensor networks,” in Proc. IPSN, 2008, pp. 245–256.
[8] O. Salem, Y. Liu, A. Mehaoua, and R. Boutaba, “Online anomaly detection in wireless sensor networks,” in Proc. J. Biomed. Health Informat., vol. 18, no. 5, pp. 1541–1551, Sep. 2014.
[9] A. Sheshadi, M. Luk, A. Perrig, L. van Doorn, and P. Khosla, “SCUBA: Secure code update by attestation in sensor networks,” in Proc. Workshop Wireless Security, 2006, pp. 85–94.
[10] F. Liu, X. Cheng, and D. Chen, “Insider attacker detection in wireless sensor networks,” in Proc. 26th IEEE INFOCOM, 2007, pp. 1973–1945.
[11] Vittorio P. Illiano and Emil C. Lupu, “Detecting Malicious Data Injections in Event Detection Wireless Sensor Networks”, IEEE Transactions OnNetwork And Service Management, September 2015.
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