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A Survey on Secure Data Routing in Wireless Sensor Networks

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Abstract - Wireless Sensor Networks (WSN) is, to put it simply, distributed sensor networks in which the nodes are sensing and detecting devices. Because of the wireless nature of WSN sensors' communication, the network's physical layout may vary and adapt to new situations. It consists of tiny nodes with the capacity for sensing, processing, and wireless communication. Numerous routing, power management, and data dissemination protocols have been developed specifically for WSNs, for which energy efficiency is an important design consideration. It is possible for routing protocols in WSNs to vary depending on the nature of the network and the tasks it is designed to do. This article covers wireless sensor network safe routing algorithms (WSNs) (WSNs). Following a review of trust models in WSNs, we study routing strategies and cluster-based trust management in depth. In addition, cluster head selection and trust-based routing methods are supplied. We look at each routing paradigm's design choices between minimizing energy use and communication overhead. Also, we weigh the pros and cons of all feasible routing methods.

Keywords — Wsn, Routing, Trust, Cluster Head, Survey, Attacks, Security

I. INTRODUCTION

WSNs are rapidly gaining popularity as a means of providing ubiquitous computing environments for various applications [1]. Energy constraint is the most critical issue in all of these environments. Due to the significant energy consumption involved with radio transmission and reception, the inherent restricted battery capacity of network sensor nodes is one of the greatest obstacles in wireless sensor networks. As a result, battery power is a critical parameter in designing algorithms that extend the life of network nodes [2].

Clustering is used in WSNs to address the above mentioned issue due to its scalability, energy-saving characteristics, and network topology stability [3]. A cluster head can be one node with a disproportionate amount of resources. The user may specify the total number of cluster heads in the network, and the number of nodes in each cluster may [4]... Additionally, cluster heads can establish a second-tier network, i.e., by establishing

another hierarchy level or transmitting data to the base station [5-9]. On the other hand, individual clustering schemes have some drawbacks, including increased overhead associated with cluster head (CH) selection, assignment, and construction. Along with maximizing sensor node life, it is preferable to distribute energy dissipated throughout the WSN to maximize overall network performance [10-13].

Dense node deployment, network design flexibility, low duty cycle, battery life constraints, and multi-hop communication are all hallmarks of a WSN [14–19]. Self-configurable sensor nodes may be mobile or stationary in WSNs, and there can be both homogeneous and heterogeneous sensor nodes. Due to their nature as broadcasts, sensors dispersed in a hostile environment pose a risk for various harmful assaults. An attacker may, for instance, examine the network's traffic flow and take impulsive action against it[20-27 WSNs are vulnerable to a variety of threats. The resource dependability and efficiency of any WSN with clustered WSNs should be paramount. WSNs are used for a range of purposes in addition to industrial automation, agriculture, healthcare, the military, and robots. Most route-finding challenges in WSNs include security, node location, energy consumption, communication range, fault tolerance, and quality of service... Due to economic loss and privacy issues, increased emphasis is being paid to the security of WSNs [26-29] Along with clustering, security is a critical component of current research. Traditional security techniques such as public- key cryptography, authentication, and others cannot be used directly due to their computational requirements. Each sensor node in WSNs has restricted memory, battery life, processing, and communication capabilities. As a result, cryptography and authentication techniques alone cannot distinguish acceptable nodes among many neighbors to provide safe message routing from source to destination in WSNs. As a result, a new security system is required for WSNs that consumes fewer network resources and can identify neighbor node activity to discriminate between benign and malicious nodes and allow trustworthy nodes to participate solely in routing. This novel approach to securing WSNs is called trust-based security [30].

Numerous studies have been conducted in recent years,

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examining various elements of WSNs, including low-power protocols, network setup, routing methods, and coverage issues. This chapter discusses numerous properties and characteristics of several well-known trust-based clustering algorithms for WSNs, as well as certain meta heuristic optimization techniques for CH selection and trust-based safe routing for WSNs [31]. It discusses the primary design issues and develops trust model countermeasures for security issues. Additionally, it clarifies prior trust models utilized in various WSN decision-making methods [32-37].

2 .TRUST MODELS IN WSN's

The degree of belief created between a source and a destination node due to past contact and behavior is the definition of trust. Trust influences future route selection and communication in wireless sensor networks.

Trust can be calculated in three ways

• Direct Trust

When nodes directly trust one other, the network is said to be "source-directed." The direct connection between nodes makes the assessment of direct trust. Greater weight should be given to this than either implicit or recommendation-based trust.

• Indirect Trust

When a source node cannot communicate with a target node directly, it receives information about the target node's behavior through other nodes.

• Recommended Trust

The suggestion spreads information about the target node to its neighbors and is an element of indirect trust. It relies on the established relationships between the target node and its neighbors.

Different types of security risks may be categorized based on the actions of the malicious node:

- **Black hole attack**

A Black hole attack is launched when a malicious node pretends to be the network's official route and steals all packets and routing information.

• Selective forwarding attack

In this attack, a malicious node masquerades as a router and drops certain packets, perhaps preventing the intended message from being sent.

• Bad Mouthing attack

In this attack, the malicious node propagates false information about its neighbor.

• Denial of Service (DoS) attack

At the heart of a Denial of Service (DoS) attack is a malicious node's attempt to deceive the system by injecting bogus data into the network. In this case, the undesired node has a bad reputation and makes false statements about other nodes.

• Sybil attack

This malicious node has numerous Ids and serves as different nodes.

• Collusion attack

Multiple malicious nodes provide misleading information and feedback on a good node in this attack.

II. LITERATURE SURVEY

SURVEY ON ENERGY-EFFICIENT WSN

1. Azarhava, H., & Niya, J. M. (2020). Energy-Efficient Resource Allocation in Wireless Energy Harvesting Sensor Networks [1]

Present a novel system model in which wireless sensors collect the requisite energy for data transmission using the harvest-then-transmit protocol. The sensors employ TDMA to interact with a Hybrid Access Point in the remaining period. By placing restrictions on the scheduling parameter and transmission power for each sensor, the authors derive the optimization issue for energy efficiency as the system's performance. The authors solve the issue using the Dinkelbach method and derive the closed-form formulas. The numerical findings indicate that while the throughput may fall somewhat compared to the other techniques, the energy usage would reduce much more than the other approaches, resulting in a more energy-efficient network.

2. Ben Fradj, H., Anane, R., Bouallegue, M., & Bouallegue, R. (2017). A range-based opportunistic routing protocol for Wireless Sensor Networks.[2]

Showed a novel approach to opportunistic routing in wireless sensor networks. This work's primary purpose is to reduce the number of FWD lists for each source, minimizing each node's energy consumption. This result is shown by contrasting the original EXOR opportunistic routing system, EEOR, with the newly suggested ROR protocol. Energy-Efficient Channel Accessing (EECA) protocol is suggested to give access to contesting nodes for the shared media by Bhavitha, K. et al. [3]. It enhances the Wireless Sensor Networks average waiting time and energy efficiency. In this protocol, the contesting nodes are regularly scheduled to access the shared media based on their priorities, preventing low- priority nodes from going hungry. This leads to the efficient usage of node energy. In addition, the network's security is maintained by identifying harmful activities. The authors plan for the EECA protocol to be adopted by all scalable network access channels.

3. Deepakraj, D., & Raja, K. (2021). Hybrid Data Aggregation Algorithm for Energy Efficient Wireless

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Sensor Networks.[4]

Developed the hybrid data aggregation method for active data processing in WSN using an improved aggregation approach. The suggested method picks the cluster head more effectively than comparable methods—the cluster leader functions as an aggregator who avoids duplicate and unnecessary data. The sensors are separated into dormant and active nodes to save energy. In addition, the suggested method has been assessed in terms of Delay, network lifespan, and power usage.

4. Jie Hao, Guojian Duan, Baoxian Zhang, & Cheng Li. (2013). An energy-efficient on-demand multicast routing protocol for wireless ad hoc and sensor networks.[11]

EMP is an on-demand, destination-driven, efficient multicast routing method for use in wireless ad hoc and sensor networks that conserves power. Energy-criticality avoidance and destination- driven features are two ways EMP improves the on- demand multicast tree-building process... EMP is straightforward to build, requiring little data storage at nodes. Simulation findings indicate that EMP may significantly enhance network longevity compared to current methods.

5. Junli, F., Yawen, W., & Haibin, S. (2017). An improved energy-efficient routing algorithm in software defined wireless sensor networks

Junli F. et al. [12], using SDWSN, Introduce an innovative method for energy-efficient routing. The suggested routing algorithm decreases broadcasting and receiving energy consumption using SDN's centralized control and topology management. Additionally, each node is linked to its nearest neighbor, which reduces transmission energy. The simulation findings indicate that the unique routing approach created by the authors significantly increases the network's lifetime while maintaining constant energy consumption.

A SURVEY ON LEACH PROTOCOL IN WSN

1. Fei, X., Wang, Y., Liu, A., & Cao, N. (2017). Research on Low Power Hierarchical Routing Protocol in Wireless Sensor Networks. [1]

The authors investigate the depth of the aquatic environment's wireless sensor network protocol. Due to the water environment, each ecosystem node is uneven and must lengthen its life cycle. The LEACH-EP procedure is suitable for aquatic environments.

2. Rahmadhani, M. A., Yovita, L. V., & Mayasari, R. (2018). Energy Consumption and Packet Loss Analysis of LEACH Routing Protocol on WSN Over DTN[25]

LEACH-energy WSN use is equivalent to LEACH-WSNoverDTN consumption. Between 0.03 to 0.15 times as much energy is used by LEACH-WSNoverDTN compared to LEACH-WSN. Using buffers, LEACH-WSNoverDTN can increase its packet delivery ratio and decrease the number of lost packets... When the buffer capacity is up to 10x the packet size, it may minimize packet loss on LEACH- WSN by up to 50 percent.

A SURVEY ON CLUSTER-BASED ROUTING IN WSN

1. Fei, X., Wang, Y., Liu, A., & Cao, N. (2017). Research on Low Power Hierarchical Routing Protocol in Wireless Sensor Networks. [1]

The artificial bee colony (ABC) technique suggested in this paper efficiently balances power consumption, hence conserving energy and extending the network lifespan of a clustered network, as shown in section 5's simulation findings. This is because the random swarm component of the ABC method helps determine the ideal sensor node forwarding pathways. For scalability, the proposed technique leverages a static setup stage to construct a hierarchical sensor network with cluster leaders possessing more capacity than member nodes.

2. Sreevidya, B., & Rajesh, M. (2017). Enhanced energy optimized cluster based on demand routing protocol for wireless sensor networks.

Using the NS2 simulator to create and simulate an energy-efficient cluster-based routing protocol. A protocol test was conducted with 20, 40, 60, and 80 nodes. All nodes, except the source and the destination, travel in random directions and at random speeds, with a maximum speed of 5m/s. It is noted that End-to-End Delay and Energy usage have improved. Using the new protocol, the lifespan of the sensor nodes has been extended. Traditional AODV is compared to the procedure. This study will propose an energy-efficient data aggregation approach so that routing overhead may be minimized further, hence enhancing the Energy Consumption and Lifespan of sensor nodes.

3. Vancin, S., & Erdem, E. (2017). Performance analysis of the energy efficient clustering models in wireless sensor networks

In this paper, In distributed WSNs, In this paper, we study the heterogeneous protocols SEP, DEEC, CEEC, and SEED, and we compare them to the energy-efficient clustering algorithms LEACH, mod-LEACH, and PEGASIS. The authors compared the performance of the SEED protocol under two unique situations to that of the SEP, DEEC, and CEEC protocols in terms of criteria, network lifespan, and packets transmitted to the base station in a MATLAB simulation environment. In terms of parameters and energy usage, the SEED technique outperforms other approaches. The first and second results, which reduce energy consumption, extend the network's life.

4. Zhao, G., Li, Y., & Zhang, L. (2019). SSEEP: State-

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Switchable Energy-Conserving Routing Protocol for Heterogeneous Wireless Sensor Networks.

For heterogeneous WSN, the authors alter the LEACH methodology. Adding a data transmission switch to regulate data transmission enables users to get just the data they're interested in, cluster's head and sink are said to be d0 light-years apart..; they regulate the number of head nodes to be as close to ideal as feasible. In addition, this technique has excellent scalability and does not need any predetermined node position information, making it suited for large-scale networks.

A SURVEY ON SECURE DATA TRANSMISSION IN WSN

1. Fukuda, K., Takyu, O., Shirai, K., Ohta, M., Fujii, T., Sasamori, F., & Handa, S. (2018). Transmit control and data separation in physical wireless parameter conversion sensor networks with event-driven sensors [6]

The authors suggested the data separation approach and transmitted control for the event-driven sensor in the hysical wireless parameter conversion sensor network (Phys-SN).

2. Gonzalez, O. B., & Chilo, J. (2020). WSN IoT Ambient Environmental Monitoring System.[8]

Construct an IoT-based, wireless sensor network for monitoring the environment, and put it through its paces in three different locations. The gateway has been set up to provide access through MQTT and SSH. The gateway, sensors, and transceivers all contributed to the ease with which the WSN could be set up and connected to the Internet throughout the network configuration. It facilitates the quick installation of the WSN IoT system, which gathers data for cloud-based machine learning methods such as artificial neural networks (ANN) and other machine learning techniques... Node-Red was used on the GW's operating system to allow Internet-accessible data collecting, processing, storage, and visualization.

3. Jiren, X., Hongbin, Y., Jin, Z., Dongsheng, W., & Xiaolan, Z. (2021). Design and Implementation of a Timing and Calculating Rings System Based on RFID and WSN.[10]

Offer a self-timer problem for many middle- and long-distance runners based on RFID and WSN. Currently, two nodes are originally placed on the normal 400-meter runway. With the aid of the WSN network, 16 data are tallied at a distance of 3,000 meters after scanning the RFID tags on pupils. The difference between 800m and 3000m when each point's exercise time is recorded and compared to manual timing findings is less than one second. The RFID and WSN-based physical fitness assessment system can automate workout schedules. This study investigates the collection and transmission of data in track and field sports using the automated lap recording approach. It suggests employing RFID technology and WSN for data collection, processing, and transmission to automate counting the number of laps athletes marching.

4. Kim, H., & Kim, J. (2011). Energy-efficient resource management in Wireless Sensor Network. [14]

The authors demonstrate significantly reducing the energy squandered by nodes. that nodes may save energy by lowering the active mode duration under a given SINR limit because most nodes closest to the base station have an SINR greater than. Although the authors obtain significant energy savings with nodes having the same transmit power, sensor nodes have a detrimental energy consumption rate, resulting in various node life cycles. Therefore, adaptive transmit power regulation based on channel conditions minimizes energy consumption and operating time, minimizing energy consumption.

5. Liu, J., Yin, H., Xing, F., Ji, X., & Wu, B. (2018). An Energy-Efficient Routing Algorithm for Underwater Wireless Optical Sensor Network. [15]

The routing performance of an underwater communication network is significantly affected by energy management. This article explains a balanced, distributed, energy-efficient routing technique for underwater wireless optical sensor networks. Both static and dynamic networks are compatible with the DEEB algorithm. Simulation results demonstrate that the DEEB algorithm can significantly decrease routing energy consumption, balance nodes' energy load, and enhance nodes' work time compared to the two existing techniques.

6. Liu, S. (2017). Optimization analysis of WSN location process based on hybrid PSO algorithm. [16]

Based on enhancing the hybrid Particle Swarm Optimization (PSO) strategy and the accompanying mathematical simulation findings increases the WSN localization process's location accuracy and response time. In the WSN location technique, the upgraded hybrid Particle Swarm Optimization (PSO) approach addresses the conflict between location accuracy and location time... At the same time, it improves the computational efficiency of the WSN localization approach.

Neha, & Banita. (2020). Energy Efficient Routing in Wireless Sensors Networks. [18]

Have reviewed several research publications. Each study proposes a unique method for optimizing energy usage and boosting security, such as CCMAR, TTPP, RHCS, LEACH-C, etc. Each tactic includes a unique approach, and standard procedures have been compared. In the future, the authors will offer energy-efficient and dependable methods for maximizing network longevity and throughput.

7. Nishikawa, Y., Sasamura, T., Ishizuka, Y., Sugimoto, S., Iwasaki, S., Wang, H., … Kurihara, K. (2018). Design of stable wireless sensor network for slope

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monitoring. [19]

The WSN technology was used to develop the remote slope monitoring system. It was discovered that several non-ideal elements compromise the real outer field monitoring. In communication terminal has been suggested for the long-term operation of the system. In addition, the state of the field may be anticipated using the system's gathered data.

8. Pandey, S., & Kumar, R. (2018). Study of Routing Protocol Using Key Management in Wireless Sensor Network. [20]

WSN is the most well-known field of this generation. Numerous applications include warfare, medical, fire detection, mudslide detection, etc. The wireless sensor network is a tiny, cost-effective gadget. Therefore, its popularity has increased significantly. This article discusses some of the essential management strategies for wireless sensor networks. As described before, a routing protocol employs a variety of crucial network security mechanisms. WSN utilizes protocols; however, security no longer exists in the network. The writers explore the merits and downsides of several methodologies and procedures. This study examines and contrasts all Key management strategies. According to this poll, the recommended procedures need some adjustment.

9. Pandey, S., & Kumar, R. (2018). Study of Routing Protocol Using Key Management in Wireless Sensor Network. [21]

Patel, S. T., and N. H. Mistry [21] this article examined many defense strategies against the Sybil assault. Additionally, other procedures impacted by the Sybil assault are examined and explained. The research concludes that these diverse techniques aid in detecting and preventing Sybil attacks. The authors discovered that the examined approaches are used at the application layer and offer protection against Sybil attacks. The simulation results of the several examined algorithms demonstrate that the suggested algorithms function effectively and give the desired level of security. This paper offers information that researchers on this subject may find interesting. The authors provide an innovative method for low-latency and energy-balanced data transmission across small-world WSNs.

10. Pandey, O. J., & Hegde, R. M. (2018). Low-Latency and Energy-Balanced Data Transmission Over Cognitive Small World WSN.[22]

A strategy for building a tiny cognitive environment using a probabilistic model of link introduction is provided. The probabilistic link introduction model uses network and node parameters such as the number of hops and the sensor node's distance from the sink. In addition, a unique form of data transmission is created by modifying the energy costs associated with sensor node networks that use excess energy... Existing energy balance and data delay reduction approaches are compared to results addition, adaptive powering control for the achieved using heuristic and suggested methods. imulations and a physical WSN test bed are used to generate experimental findings. Compared to existing approaches such as LEACH, multi-hop, and direct data transfer protocols, the proposed solution extends network lifetime and reduces data latency through WSN.

11. Rathinam D, D. K., D, S., A, S., A, S. G., & J, S. (2019). Modern Agriculture Using Wireless Sensor Network (WSN).[26]

Utilizing the most advanced technology, agriculture is possible in today's globe. Here, WSNs are used to cultivate a crop with a high yield and cheap cost. Today, humans are no longer active in agriculture. To decrease human labor, wireless sensor networks are used. Here, sensor nodes gather data and transmit it to farmers and agricultural experts. Using extra hardware and software, smartphones receive data transmissions. The farmer can use mobile phones from any location at any time. This application can accommodate several farmers and professionals. This is more ideal for nations depending on agriculture, such as India.

12. Rathinam Swain, A., Ray, A. K., & Kumar Swain, P. (2018). An Analytical Model for WSN-MCN Convergence Network Based on Processor Sharing Scheduling[28].

A Processor Sharing (PS) analytical scheduling model has been presented for the WSN MCN convergence network. This methodology examines incoming WSN and MCN requests by implementing a two-phase procedure at each mobile station. Utilization and throughput have been estimated and examined during both stages. The throughput and utilization increase higher for the suggested approach since simultaneous requests are handled at a slower pace in both stages of the process.

13. Sachan, A., Nigam, S., & Bajpai, A. (2018). An Energy Efficient Virtual-MIMO Communication for Cluster Based Cooperative Wireless Sensor Network[29]

This research used the Inference approach to determine the convergence of sensor network values. This is achieved by extracting information logically from the network. This logical extraction provides more precise predictions of the relevant variables than aggregation alone. The authors ultimately realized the performance and reliability advantages of the concept. The convergence of data is superior to data aggregation.

14. Sharma, H., Haque, A., & Jaffery, Z. A. (2018). An Efficient Solar Energy Harvesting System for Wireless Sensor Nodes[30].

This functional model simulates an efficient solar energy collecting system for WSN nodes using MPPT in MATLAB/SIMULINK. Maximum Power Point Tracking (MPPT)-based technology rapidly charges the battery.

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While being increase. The energy harvesting circuit's overall efficiency (!sys) is equal to the product of the Boost converter's efficiency and the MPPT's efficiency. The simulation findings reveal that the MPPT-based Solar Energy Harvester has a system efficiency of 96.28 percent.

15. Sana, M., & Noureddine, L. (2019). Multi-hop energy-efficient routing protocol based on Minimum Spanning Tree for anisotropic Wireless Sensor Networks.[31]

This article describes a routing strategy for wireless sensor networks with numerous hops. Since it is based on Minimum Spanning Tree (MST) graph theory, this approach applies to both isotropic and anisotropic deployment zones. The authors use hop count to measure data transit from nodes to the sink with the fewest possible hops. The authors studied a WSN of random sensor nodes distributed in a square sensing area. All of these simulation results were generated using MATLAB 2015a. The authors adjust the routing measure for tree formation based on the minimum hop count and node distances. To demonstrate the effectiveness of the authors' route optimization approach, a comparison is made between two routing measures. The simulation results reveal that minimum hop routing is superior to distance-based routing and minimizes the number of sensor nodes engaged in data packet transmission.

16. Tumuluri, R., Kovi, A., & Raju Alluri, B. K. (2018). An Energy-efficient algorithm using layer heads for Software-Defined Wireless Sensor Networks

Proposed a layer-based strategy for energy efficiency in multidimensional space. The authors recommended a layer head for each energy sector, extending the network's lifespan. According to the experimental findings, the suggested technique successfully decreases energy usage without increasing computing complexity. Here, we describe a technique for determining the optimal number of energy spaces that strikes a good compromise between system performance and algorithmic complexity.

17. Vinutha, C. B., Nalini, N., & Veeresh, B. S. (2017). Energy efficient wireless sensor network using neural network based smart sampling and reliable routing[35]

Vinutha, C. et al.[35] Wireless Sensor Networks have lately found applications in almost all communication system fields. The most precious resource in WSN nodes is battery power. The ability to manage and enhance wireless sensor network communication power is provided. Using intelligent sampling, we can reduce the unnecessary and correlated periodic sampling of static nodes that accounts for a significant portion of the network's overall energy usage. The shortest route between the source and the destination is determined charged, both the battery's SoC and terminal voltage using a BPNN-based reliable routing algorithm that predicts the optimum nodes. This prevents battery drain from retransmissions after packet loss. Matlab code is used to achieve the design of the system. In contrast to earlier studies, the performance is assessed based on energy usage, end-to-end Delay, and sample rate. Graphical study reveals that the efforts of these authors are better in every respect: Energy Consumption dropped by 27.2%, Delay by 52.8%, and Sampling Rate by 30.9%. This research might be improved by doing real-time tests on a test bed and comparing simulation findings to actual data.

18. Wen, W., Dong, Z., Chen, G., Zhao, S., & Chang, C.-Y. (2017). Energy Efficient Data Collection Scheme in Mobile Wireless Sensor Networks[37]

EDCM is this study offers a successful data gathering method for mobile wireless sensor networks. The proposed EDCM selects collecting locations with the highest potential for energy savings. The simulation findings indicate that the authors' EDCM decreases energy consumption and increases the Apart from these qualities, sensor nodes encounter network's lifetime compared to other systems.

19. Zhai, J., Zhang, H., Li, Y., & Zhang, Y. (2010). Energy Efficient RF Front-Ends Architecture Design for Wireless Sensor Networks [39]

Each architecture's energy model and accompanying modulation are explored in depth. The design of a low-power WSN RF front-end for various transmission durations and data rates is shown. Simulation findings indicate that OOK and QPSK systems are more energy-efficient for short-range communication, whereas MSK is more energy-efficient for long-range communication. At low data rates (200kbps) and transmission durations of 10m or less, OOK, BPSK, and QPSK are more energy-efficient than MSK; however, MSK is more energy-efficient at high data rates.

Table 3.1

Feature	Centralized	Distributed	Hybrid
Depends on	Base station	Witness orneighbor	Both
Scalability	Less	High	Medium
Advantages	1. High Accuracy 2. Less communication overhead 3. Improved network lifetime	1. Supporting dynamic network topology 2. Less overhead	Better network lifetime and detection accuracy
Limitations	Singlepoint of failure	It can only prevent the replica attacksbut not detect the attackers	High communication overhead and complexity

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Apart from these qualities, sensor nodes encounter significant challenges when detecting replication attacks in static and mobile WSNs. These are localization, network structure, power consumption, and the base station. Table 3.1 summarizes the security concerns associated with WSN.

Table 3.2 Security Issues in WSN

SecurityIssues	Static WSN	Mobile WSN
Localization	The replica detection schemeidentifies the node location information during network initialization	The node mobility tends the security scheme to estimate the node location frequently
Network Topology	It depends on the routing table or current route experience for data forwarding	The routing table information is outdated rapidly due to node mobility, andso the neighboring nodes are updated frequently to improve the accuracy of replica detection schemes.
Power Consumption	The transmission of messages incurs a significant power consumption in a node	The mobile nodes require extra powerfor mobility and attack detection
Base station	With a clustered WSN, routing and aggregation of information minimize network traffic. This aids the base station in swiftly identifying attackers.	The mobile base station collects the sensor nodes' location and sensed data. This reduces the number of transmission hops inthe communication.

A distributed replica detection scheme with cluster tree-based network topology is considered in the proposed work. The static WSN is considered for its simplicity based on the limitations in mobile sensor networks, as specified in table 3.2.

III. CONCLUSION

Routing in sensor networks is a relatively young study field with a limited but developing body of work. This study presents a complete evaluation of trust-based routing algorithms for WSNs documented in the literature. They all attempt to prolong the sensor network's lifespan without affecting data transmission. Depending on the network topology, routing protocols are divided into flat, hierarchical, and location-based. CH-based routing solutions are protocol-dependent. In addition, we address the tradeoffs inherent in several routing paradigms between energy and communication overhead reductions, as well as the benefits and drawbacks of each routing strategy. Even though some of these routing solutions look promising, sensor networks face additional difficulties.

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