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# EKM-Cl: Novel Framework for Key Management in Dynamic Wireless Sensor Networks

Raksha R S<sup>1</sup>, Shiva Murthy G<sup>2</sup>, Ramakrishna Prasad A L<sup>3</sup>

<sup>1, 2, 3</sup> Department of Computer Science and Engineering, Visvesvaraya Technological University, Center for Postgraduate Studies, Muddenahalli, Chikkaballapur - 562101, India

**Abstract:** Key management has remained a difficult issue in wireless device networks (WSNs) as a result of the constraints of device node resources. Various key management schemes that trade off security and operational necessities are proposed in recent years. Wireless device Networks (WSNs) comprises tiny sensor nodes with strained energy, memory and computation capabilities. They are typically deployed within the unattended and hostile environment. So device nodes are unit susceptible to attacks such as node capture and collusion attack by adversaries. In this paper, we tend to propose a certificate less-effective key management (CLEKM) protocol for secure communication in dynamic WSNs characterized by node mobility. The sending node first calculates the best shortest path to the base station and sends the key updates. A security analysis of our theme shows that our protocol is effective in defensive against varied attacks. We tend to implement CL-EKM in Conic OS and simulate it exploitation Cola machine to assess its time, energy, communication, and memory performance.

**Keywords:** Key Management; Wireless Sensor; Cola machine; node mobility;

## I. INTRODUCTION

Dynamic wireless sensor networks (WSNs) which empower portability of sensor hubs, encourage more extensive system scope and more precise administration than static WSNs. There-fore, dynamic WSNs are by and large quickly embraced in checking applications, for example, target following in battlefield reconnaissance, social insurance frameworks, traffic flow and vehicle status observing, dairy cows wellbeing observing [9]. In any case, sensor gadgets are powerless against pernicious assaults, for example, pantomime, block attempt, catch or physical decimation, due to their unattended agent conditions and slips by of availability in remote correspondence [20]. Accordingly, security is one of the most imperative issues in numerous basic dynamic WSN applications. Dynamic WSNs in this manner need to address key security prerequisites, for example, hub validation, information confidentiality furthermore, honesty, at whatever point and wherever the hubs move To address security, encryption key administration conventions for dynamic WSNs have been proposed in the past in view of symmetric key encryption [1]– [3]. Such sort of encryption is appropriate for sensor hubs due to their constrained vitality and preparing capacity. Notwithstanding, it experiences high correspondence overhead and requires expansive memory space to store shared pair wise keys. It is likewise not adaptable and not flexible against bargains, and unfit to help hub portability. Thus symmetric key encryption is not appropriate for dynamic WSNs. All the more as of late, awry key based approaches have been proposed for dynamic WSNs [4-7], [10], [15]. These methodologies exploit of public key cryptography (PKC, for example, elliptic bend cryptography (ECC) or Identity based public key cryptography (ID-PKC) so as to streamline key foundation and information validation between hubs. PKC is generally more costly than symmetric key encryption as for computational expenses. Be that as it may, late changes in the execution of ECC [11] have exhibited the plausibility of applying PKC to WSNs. We tend to show the safety weaknesses of existing ECC based mostly key management schemes for dynamic WSNs. CL-EKM supports four sorts of keys, every of that is used for a special purpose, as well as secure pair-wise node communication and group-oriented key communication among clusters. Economical key management procedures are unit outlined as supporting node movements across completely different clusters and key revocation method for compromised nodes.

## II. RELATED WORK

According to the secure communication demand in WSN, 2 varieties of key institution are needed. One is pair wise key institution; the opposite is cluster key institution. A few schemes has been projected that incorporates 3 phases normally [10]: (1) key setup before deployment, (2) shared-key discovery once preparation, and (3) path-key institution if 2 sensor no desdon't share an on the spot key. The most in style pair wise key pre-distribution answer is Random Pair Wise Key theme [11] which addresses unessential storage

drawback and provides some key resilience. It's supported Erodes and Reni's [12] work. Every sensing element node stores a random set of Nape pair-wise keys to achieve chance  $p$  that 2 nodes are connected. Neighboring nodes will tell if they share a common pair-wise key once they send and receive "Key Discovering" Message inside radio range. Its defect is that it sacrifices key property to decrease the storage usage. Closest (location-based) pair-wise keys pre-distribution theme [13] is another to Random pair wise key scheme. It takes advantage of the situation data to enhance the key connectivity. Later on, Random key-chain based mostly key pre-distribution answer is another random key pre-distribution solution that originated from the answer of basic probabilistic key redistribution scheme [14]. It depends on probabilistic key sharing among the nodes of a random graph.

There are many key reinforcement proposals to strengthen security of the established link keys, and improve resilience. Objective is to firmly generate a novel link or path key by using established keys, so the secret's not com- secure once one or a lot of sensing element node is captured. One approach is to extend quantity of key overlap needed in shared key discovery phase. Q-composite random key pre-distribution theme [11] needs letter common keys to establish a link key. Similar mechanism is projected by Pair-wise key institution protocol [15] that uses threshold secret sharing for key reinforcement. The key reinforcement solutions in general increase process and communication quality; however give smart resilience in the sense that compromised key-chain doesn't directly have an effect on security of any links within the WSN. But, it should be doable for Associate in Nursing oppose to re-cowl initial link keys. Associate in Nursing oppose will then recover strengthened link keys from there recorded multi-path reinforcement messages once the link keys are compromised. Symmetric key schemes don't seem to be viable for mobile detector nodes and so past approaches have targeted solely on static WSNs. a couple of approaches are planned supported PKC to support dynamic WSNs. Thus, during this section, we review previous PKC-based key management schemes for dynamic WSNs and analyze their security weaknesses or disadvantages. Chuang et al. [7] and Agawam et al. [8] planned a two-layered key management theme and a dynamic key update protocol in dynamic WSN supported the Daffier-Hellman (DH), severally. However, both schemes don't seem to be fitted to sensors with restricted resources and area unit unable to perform valuable computations with massive key sizes (e.g. a minimum of 1024 bit). Since computer code is computationally additional economical and features a short key length (e.g. 160 bit), many approaches with certificate are planned supported computer code. However, since every node should exchange the certificate to ascertain the pair wise key and verify every other's certificate before use, the communication and computation overhead increase dramatically. Also, the BS suffers from the overhead of certificate management. Moreover, existing schemes don't seem to be secure.

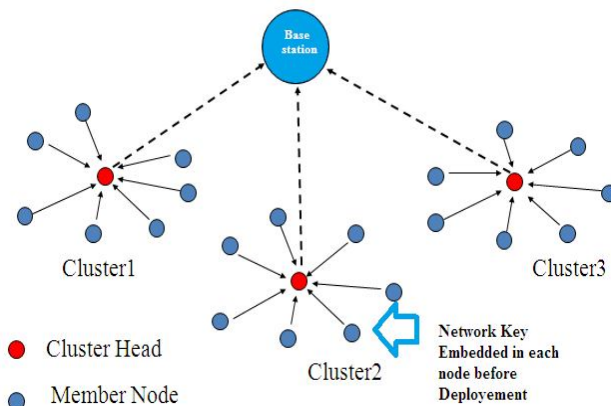


Fig 1: Wireless Sensor Networks Architecture

### III. SYSTEM MODEL & ANALYSIS METRICS

#### A. System Model

The basic system model of this paper is pictured in Figure. 1. It consists of 1 BS and lots of uniform sensing element nodes with distinctive ID. It uses cluster and two-layer design for scalability. Every cluster has some key generation nodes (KGNs) that distribute point keys among that cluster. These KGNs is also the final sensing element nodes elect by cluster heads (CHs). We assume that the fundamental system model is deployed for the purpose of watching the hostile atmosphere. End-to-end node communication is unusual as a result of sensing element nodes in each cluster monitor the finite space. For their info aggregation, there square measure several communications between the nodes among the same cluster. Thus, the most task of this model could be a information transfer from sensing element nodes to BS and an information aggregation in every cluster.

#### IV. PROPOSED SCHEME

This paper introduces an Energy-Efficient Dynamic KeyManagement (EEDKM) proposal that uses two-layer architecture. In the lower layer, similar to LOCK, rekeying is performed confined using the EBS and the  $t$ -degree vicariate polynomial. Each cluster has a clear number of KGNs which makes it hard that an attacker can expose the network keys by obtaining some KGNs. In upper layer, rekeying is performed using the secret key between BS and sensor node. The secret key is loaded before in each sensor node with unique ID and authenticates the node to the BS. The BS generates one  $t$ -degree vicariate polynomial key and distributes it by means of session key shared by all CHs. This makes the communication between CHs efficient. The rest of this section describes the bootstrapping, initial key distribution mechanism and some general operations in our key management scheme. This may help you to understand our scheme.

#### V. OVERVIEW OF THE CERTIFICATE LESS EFFECTIVE KEY MANAGEMENT AND SECURITY MODEL SCHEME

**KEY MANAGEMENT** Before WSN will exchange information firmly, encryption keys should be established among sensing element nodes. Key distribution refers to the distribution of multiple keys among the sensing element nodes, which is typical in an exceedingly non-trivial security theme. Key management could be broader terms for key distribution, which conjointly includes the processes of key setup, the initial distribution of keys, and key revocation the removal of a compromised key. The CL-EKM is comprised of 7 phases: system setup, pair wise key generation, cluster formation, key update, node movement, key revocation, and addition of a new node.

The CL-EKM is comprised of 7 phases: system setup, pair wise key generation, cluster formation, key update, node movement, key revocation, and addition of a new node. Secure key management theme for WSNs supporting mobile nodes, the following security properties are critical: mobile nodes, the following security properties are critical.

##### A. *Compromise-Resilience:*

A compromised node should not affect the protection of the keys of different legitimate nodes. In different words, the compromised node should not be in a position to reveal pair wise keys of non-compromised nodes. The compromise-resilience definition doesn't mean that a node is resilient against capture attacks or that a captured node is prevented from causing false knowledge to different nodes, BS, or cluster heads.

##### B. *Resistance Against biological research and Impersonation:*

The scheme should support no deauthentication to safe guard against node replication and impersonation attacks.

**Forward and Backward Secrecy:** The theme should assure forward secrecy to forestall a node from exploitation. Associate in nursing previous key to continue decrypting new messages. It should conjointly assure backward secrecy to forestall a node with the new key from going backwards in time to decode antecedently exchanged messages encrypted with previous keys. Forward and backward secrecy are accustomed defend against node capture attacks.

##### C. *System Setup*

Before the network deployment, the BS generates system parameters and registers the node by including it in a member list  $M$ .

1) **Generation of System Parameters:** The KGC at the BS runs the following steps by taking a security parameter  $k \in \mathbb{Z}^+$  as the input, and returns a list of system parameter =  $\{Fq, E/Fq, Gq, P, P_{pub} = xP, h_0, h_1, h_2, h_3\}$  and  $x$ .

Choose a  $k$ -bit prime  $q$

Determine the tuple  $\{Fq, E/Fq, Gq, P\}$ .

Choose the master private key  $x \in \mathbb{R} \mathbb{Z}^*_q$  and compute the system public key  $P_{pub} = xP$ .

Choose cryptographic hash functions  $\{h_0, h_1, h_2, h_3\}$  so that  $h_0 : \{0, 1\}^* \times G_2 q \rightarrow \{0, 1\}^*$ ,  $h_1 : G_3 q \times \{0, 1\}^* \times Gq \rightarrow \{0, 1\}^n$ ,  $h_2 : Gq \times \{0, 1\}^* \times Gq \times \{0, 1\}^* \times Gq \rightarrow \mathbb{Z}^*_q$ , and  $h_3 : Gq \times \{0, 1\}^* \times Gq \times \{0, 1\}^* \times Gq \times \{0, 1\}^* \times Gq \rightarrow \mathbb{Z}^*_q$ . Here,  $n$  is the length of a symmetric key. The BS publishes and keeps  $x$  secret.

2) **Node Registration:** The BS assigns a unique identifier, denoted by  $L_i$ , to each  $L$ -sensor  $nL_i$  and a unique identifier, denoted by  $H_j$ , to each  $H$ -sensor  $nH_j$ , where  $1 \leq i \leq N_1$ ,  $1 \leq j \leq N_2$ ,  $N = N_1 + N_2$ . Here we describe the certificateless public/private key and individual node key operations for  $L_i$ , the same mechanisms apply for  $H$ -sensors. During initialization, each node  $nL_i$  chooses a secret value  $x_{Li} \in \mathbb{R} \mathbb{Z}^*_q$  and computes  $PL_i = x_{Li}P$ . Then, the BS requests the KGC for partial private/public keys of  $nL_i$  with the

input parameters  $L_i$  and  $PL_i$ . The K GC chooses  $rLi \in \mathbb{Z}^*_q$  and then computes a pair of partial public/private key  $(RL_i, dLi)$  as below:

$RL_i = rLi \cdot P$   $dLi = rLi + x \cdot h_0(L_i, RL_i, PL_i) \pmod q$  The  $L_i$  can validate its private key by checking whether the condition  $dLi \cdot P = RL_i + h_0(L_i, RL_i, PL_i) \cdot P$  holds

D. Cluster Formation

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Node Discovery and Authentication
nHj → * : {Hj, pkHj}
(for i = 1, ..., n)
nLi ↔ nHj: Perform Pairwise Key Generation phase

Cluster Key Generation
(for i = 1, ..., n)
nHj : Generate GKj, Compute C2 = EkLiHj(GKj, Hj, Li)
nHj → nLi: {Hj, C2}
nLi : Decrypt C2 to get GKj and
Compute C3 = EkLiHj(Li, HMAC(kLiHj, GKj))
nLi → nHj: {Li, C3}
nHj : Decrypt C3 and Check the validity

Membership Validation
nHj : Compute C4 = EKHj(Hj, Mj), C5 = EGKj(Hj, Mj)
nHj → BS : {Hj, C4}
BS : Check Mj
BS → nHj: {Acknowledgement}
nHj → * : {C5}

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VI. EXPERIMENTAL SET UP

We use Network simulator IN java to show the performance of our proposed scheme. A WSN consists of 10 sensor nodes are randomly deployed over a square region of 1600 × 1600 m<sup>2</sup> used in this simulation. The size of the data packet is 512 bytes. Adhoc on Demand Routing (AODV) protocol is used. We have 2 cluster groups. As compared to existing scheme, our proposed scheme has better performance in terms of energy consumption, delay, and throughput. The following section shows the simulation parameters, results and comparison performance of the proposed system. Table 1 shows the simulation parameters for the proposed key management method.

Parameter	value
Field size	1600×1600 m <sup>2</sup>
Number of sensor nodes	10
Propagation type	Two ray ground
Routing type	AODV
Packet size	512 bytes
Channel	Wireless
Simulation time	3.8 seconds

VII. CONCLUSION AND FUTURE WORK

This paper proposed to the primary certificate less effective key management protocol (CL-EKM) for secure communication in dynamic WSNs. CL-EKM support economical communication for key updates and management once a node leaves or joins a cluster and thence ensures forward and backward key secrecy. Our theme is resilient against node compromise, cloning and impersonation attacks and protects the info confidentiality and integrity. This paper have a tendency to introduce a replacement theme which will be used for establish varied keys (pair wise keys, path keys and cluster keys) for wireless device networks. It is able to do quick credibility while not further computations and communications. The experiment result shows the performance of TKLU is fresh. Associate in nursing energy-efficient dynamic key management theme victimization the EBSs, polynomials and secret symmetry keys. EEDKM provides localized rekeying which is effectively performed not poignant the opposite elements of

WSN. The BS suffer from mere problem of poor encryption. Since it has four pairs of keys it is not a serious issue. Still the user or the beneficiary authority has to go for more securely encrypted key methods. This problem can be revised and solved and hence to improve this idea of secure data handling. Encryption improvement is the only method to get the most secured way of communication.

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