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# Optimized Managed Mobile Adhoc Networks Using Intermittent Clusters

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**ABSTRACT:** *We consider the problem of appropriate cluster head selection in wireless ad-hoc networks where it is necessary to provide robustness in the face of topological changes caused by node motion, node failure and node insertion/removal. The main contribution of our work is a new strategy for clustering a wireless AD HOC network and improvements in SWCA. Prior approaches didn't implement any security aspects leading to a open manet architecture which is not feasible mission critical applications. So we propose a digital certificate based Key-Request(KREQ) optimization algorithm that is void of latency factors required for rendering a certificate to support secure communications. Using these new messaging formats and combined with the above optimization algorithm we claim that node authentications and communications are secure with the possible usage of certificate schemes and the performance is highlighted through our extensive simulations.*

**Keywords-component;** ad hoc network; clusters; Load-balacing; stability

## I. INTRODUCTION

Ad hoc networks are wireless, infrastructure less, multi-hop, dynamic networks established by a collection of mobile nodes, which provides significant features to the modern communication technologies and services. In ad hoc networks, clustering is an important and familiar technique to divide the large network into several sub networks.

Cluster-based routing is a solution to address node heterogeneity, and to limit the amount of routing information that propagates inside the network.

The idea behind clustering is to group the network nodes into a number of overlapping clusters. Clustering makes possible a hierarchical routing in which paths are recorded between clusters instead of between nodes. This increases the routes lifetime, thus decreasing the amount of routing control overhead. Inside the cluster, one node that coordinates the cluster activities is known as a clusterhead (CH).

The set of clusterheads is known as a *dominant set*. Inside the cluster, there are also ordinary nodes and have direct access only to this one clusterhead, and gateways. Gateways are nodes that can hear two or more clusterheads. Groups of the nodes are organized with respect to their nearness to other nodes. Two nodes are said to be neighbors of each other when both of them lie within their transmission range and set up a bidirectional link between them.

Clustering is an important approach to solving capacity and scalability problems in mobile ad hoc networks where no physical infrastructure is available. The connected dominating set (CDS) is a special cluster structure in which the cluster heads form a connected network without using gateways. A clusterhead does the resource allocation to all the nodes belonging to its cluster. Due to the dynamic nature of the mobile nodes, their association and dissociation to and from clusters disrupt the stability of the network and thus reconfiguration of clusterheads is unavoidable. This is an important issue since frequent clusterhead changes adversely affect the performance of other protocols such as scheduling, routing and resource allocation that rely on it. The choice of the clusterheads is here based on the weight associated to each node: the bigger the weight of a node, the better that node is for the role of clusterhead.

The authors have proposed a distributed weighted clustering algorithm by making some modifications and improvements on some existing algorithms. They demonstrated that their algorithm reduces the clusterhead formation and control messages overhead thus improving overall performance and reducing energy utilization. Here, authors claimed that since energy utilization is the most important criteria in cluster based routing schemes, their protocol provides better results than existing distributed clustering algorithms.

A weight based distributed clustering algorithm (WCA) which can dynamically adapt itself with the ever changing topology of ad hoc networks was proposed. In this approach, the number of nodes is restricted to be catered by a cluster head, so that it does not degrade the MAC functioning. It has also the flexibility of assigning different weights and takes into account a combined effect of the ideal degree, transmission power, mobility and battery power of the nodes. The algorithm is executed only when there is a demand, i.e., when a node is no longer able to attach itself to any of the existing cluster heads. Clustering algorithm tries to distribute the load as much as possible.

In WCA, the number of nodes that a clusterhead can handle ideally is $\delta$. This is to ensure that clusterheads are not over-loaded and the efficiency of the system is maintained at the expected level. But how to select $\delta$ is not addressed explicitly. If $\delta$ is not well selected, many clusterheads are generated which increases energy consumption. Furthermore, computing the clusterhead serving time cannot guarantee a good assessment of energy consumption, because data communication consumes a large amount of energy and varies greatly from node to node.

Our contribution is to extend WCA by solving these inefficiencies. In using a heuristic approach, the authors give some interesting equations for the cluster density and cluster order of homogeneously distributed nodes running the DMAC algorithm. Since the DMAC structure is unique, the equations also hold in a mobile scenario if the mobility model used retains the homogeneous distribution of the nodes. If the nodes are not homogeneously distributed, the cluster density will decrease. The authors claim that the validity of their result is not restricted to the DMAC algorithm. It also holds for other algorithms that limit the cluster size to two hops.

The authors introduced a new type of algorithm called Enhancement on Weighted Clustering Algorithm [EWCA] to improve the load balancing, and the stability in the MANET. The cluster head selected efficiently based on these factors, like high transmission power, transmission range, distance mobility, battery power and energy. Since the cluster head will not be changed dynamically, the average number of cluster formations will be reduced. By applying the load balancing factor, the overhead in the cluster is reduced.

The authors develop a clustering algorithm usable by large scale ad hoc networks with high

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mobility. The main objective of their algorithm is ensure the stability of the clusters and to reduce the re-election of the cluster head. They introduce some metrics to choose the cluster head in order to respect the capacities of the node and to reflect the state of the network. They claim that these metrics merge together and provide a higher connectivity and economy of energy, as well as the best value of transmission range. The authors propose a mobility scheme to evaluate periodically the node mobility in order to expect the future state of the network. However, this scheme is complicated and requires overhead calculations.

The motivation for the present work is three-fold. First, we have identified some weakness where the authors declared that according to their notation, the number of nodes that a clusterhead can handle is ideally constrained by a value $\delta$. Second, we have identified another weakness where the authors compute the *degree-difference* for every node to ensure that clusterheads are not over-loaded. Third**,** the stability is overlooked in WCA. Consequently, we introduce our analytical models to overcome the previous inefficiencies.

## II.PROPOSED SYSTEM

In ad hoc networks, clustering is an important and familiar technique to divide the large network into several sub networks. Cluster-based routing is a solution to address node heterogeneity, and to limit the amount of routing information that propagates inside the network. The idea behind clustering is to group the network nodes into a number of overlapping clusters.

Clustering makes possible a hierarchical routing in which paths are recorded between clusters instead of between nodes. Now the difficulty is the problem of selecting a cluster heads to manage individual subnets. In this paper, we propose a Weighted Clustering Algorithm (WCA) in terms of cluster formation and stability through proper cluster head selections to mange address allocations in MANET's.

Using this approach any existing node in the network will be selected as subnet head based on some vital parameters (location, liveness) etc. That node can now be able to generate unique IP addresses for new authorized nodes and can manage their communication operations via themselves. Therefore, a new node can obtain an IP address from its neighbor nodes without broadcasting any message over the entire MANET during address allocation process.

The protocol is also highly robust and scalable in a large network. Moreover, it is capable of handling the problems that may arise due to node failures, message losses, mobility of the hosts and network partitioning or merging. Such ad hoc networks are most suitable for law enforcement, wide scale relief operations during natural disasters and military set-ups that generally have prior knowledge of forthcoming requirements. These constitute a large portion of the MANET's application.

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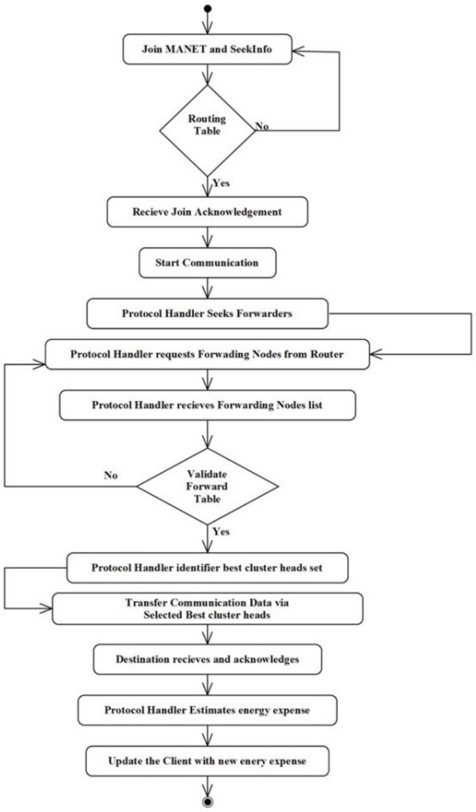



**FIG 1.ACTIVITY DIAGRAM OF UML**

1. Mobile ad hoc networks are of two types:

(A)Pure(open)
Pure (open) MANETs are formed without any prearrangements or pre-requirements. These ad hoc networks are formed spontaneously and are self-organized. The nodes in such a network do not need any prior registration.
(B)Managed
In mission critical applications, e.g., military communications, critical area surveillance, sensitive task , etc., only authorized nodes are allowed in the network. It is not easy to incorporate such authorization/authentication features in pure MANETs and hence we need managed MANET's. Managed MANETs have the provision of pre-registered or authorized nodes and have the opportunity for pre-deployed exchange of security parameters like public keys, session keys or certificates.

2. Prior approaches didn't implement any security aspects leading to a open manet architecture which is not feasible mission critical applications.
3. For upholding the security aspect in MANET's architecture usually requires usage of any of the security parameters such as public keys, session keys or certificates etc.
4. So we propose a digital certificate based Key-Request(KREQ) optimization algorithm that is void of latency factors required for rendering a certificate to support secure communications.

**Algorithm** Algorithm to process KREQ message.

Node $i$ receives KREQ=$\{S, Q, TTL, \mathcal{R}, MAC\}$
$f \leftarrow$ last node ID in $\mathcal{R}$
**if** $f \notin C_i$ OR MAC does not match **then**
  drop message and exit
**end if**
$\mathcal{R} \leftarrow \{\mathcal{R}; i\}$
**if** $Q \in C_i$ **then**
  Prepare KREP as $\{S, Q, PU_Q, \mathcal{R}\}_{PU_f}$
  Node $i$ sends KREP to node $f$
  **if** $\epsilon = 0$ **then**
    exit
  **end if**
**end if**
$TTL \leftarrow TTL - 1$
**if** $TTL > 0$ **then**
  Prepare KREQ as $\{S, Q, TTL, \mathcal{R}, MAC_{PR_i}\}$
  Broadcast KREQ
**end if**

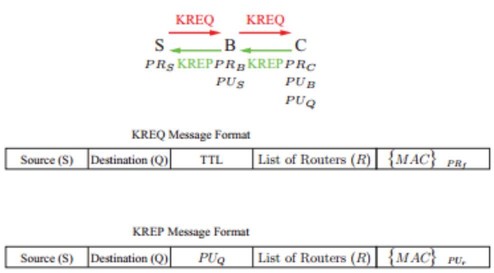
notations and variables

- $PU_i$: public key of node i;
- $PR_i$: private key of node i;
- $\{pt\}_{PR_i}$: message $pt$ signed by $PR_i$;
- $cm$: crypted message;
- $C_i$: set of nodes whose public keys are cached in node $i$;
- $N_i$: set of physical neighbors of node $i$;
- $\mathcal{R}$: list of nodes that involve in the sequence of KREQ message transmission;
- $m$: total number of public keys that each regular node caches;
- $m'$: total number of public keys that each anchor node caches;
- $\epsilon$: extensive ($\epsilon = 1$) or simple ($\epsilon = 0$) search;
- $\gamma$: ratio of the numbers of keys for local/remote nodes cached by one node;
- $TTL$: the maximum number of hops a KREQ message may travel.
- $MAC$: message authentication code.

5. The usual MANET Message Formats involved in node joining's and address allocations are as follows:
   - Route Request (RREQ) Message Format
   - Route Reply (RREP) Message Format
   - Route Error (RERR) Message Format

- Route Reply Acknowledgment (RREP-ACK) Message Format

6. For supporting certificate based schemes we introduce new messaging formats called KREQ and KREP for authenticating nodes.
7. The new messaging format and anatomy is as follows:




Message format of the KREQ and the KREP packets.

8. Using these new messaging formats and combined with the above optimization algorithm we claim that node authentications and communications are secure with the possible usage of certificate schemes and the performance is highlighted through our extensive simulations.

## II.RESULTS

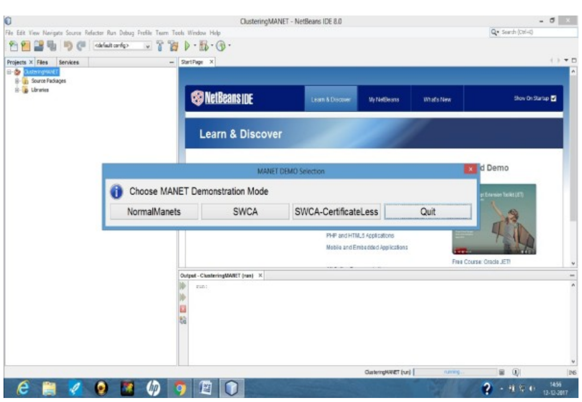



FIG 2. DEMONSTRATION MODE

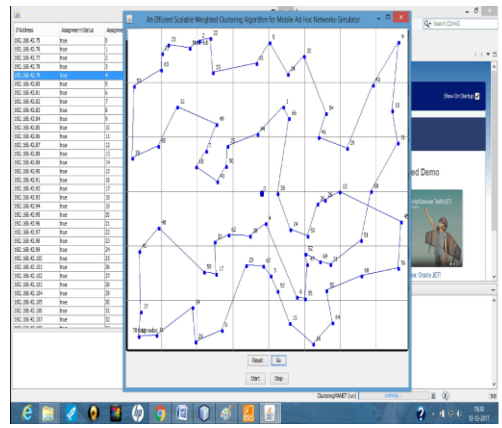


FIG 3.NORMAL MANETS

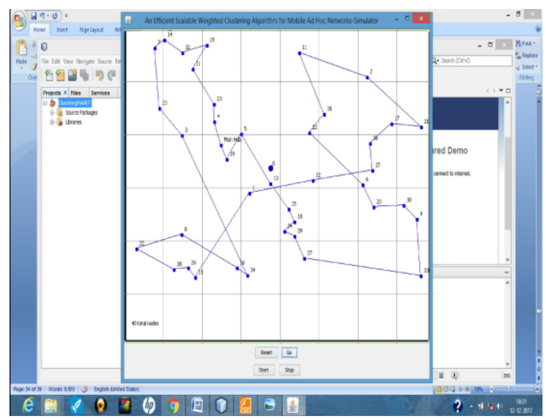


FIG 4. SWCA

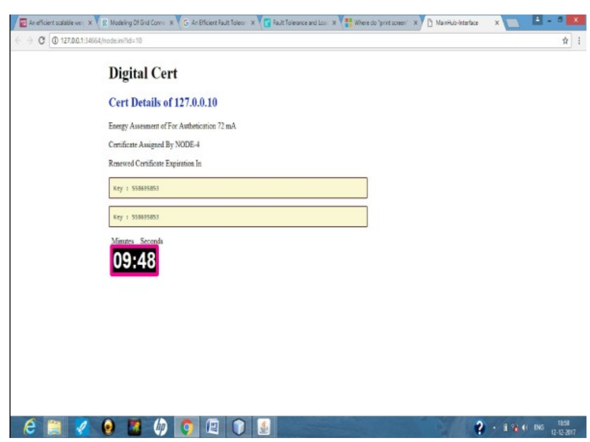


**FIG 5.SWCA CERTIFICATE LESS DIGITAL CERTIFICATE**

## IV.CONCLUSION

We have considered the problem of constructing a framework for dynamic organizing mobile nodes in wireless ad-hoc networks into clusters where it is necessary to provide robustness in the face of topological changes caused by node motion, node failure and node insertion/removal. Extending previous works, we have also mathematically derived a new clustering stability scheme. In the same objective We derived a simple clustering load balancing scheme. These two proposed schemes are considered as new mechanisms to overcome some inefficiencies detected in WCA and other similar clustering algorithms. It was shown that our proposed clustering algorithm performs similar to the best well-known algorithms (such as the WCA). The performance of our SWCA algorithm is proven by manual computation at this stage. However, we are now carrying a simulation based comparative study to validate the manual results.

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