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An Optimized Distributed Weight-Based Adaptive Stable Clustering (DWASC) Algorithm in Mobile Ad Hoc Networks

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Abstract: In mobile ad hoc network, every node is proficient of sending message (information) dynamically without constraint of any fixed infrastructure.Mobile nodes commonlyprogress in or out from the entire network dynamically, making network topology unstable in mobile ad hoc network (MANET). In a group, cluster head is dependable for communication with associates in a cluster which consumes additional battery (energy) power in evaluation to cluster members. As a message transmission result, it becomes an enormously challenging task to maintain stable network. In this paper aims to present a Distributed Weight-based adaptive stable clustering (DWASC) algorithm in NS (Network Simulator) 2.34 Framework.The proposed method the DWASC protocol operates exclusively based on source routing and on-demand process, it has been selected as the routing protocol to be executed and tested for ad hoc network application characterized by a source on-demand message conversation between nodes in a mobile ad hoc network.

Keywords: Cluster head, Clustering scheme in MANET, Adaptive stable cluster, Routing.

I. INTRODUCTION

A mobile ad hoc network (MANET) is an autonomous infrastructure less network in which collection of mobile nodes (i.e., mobile, sensor, palmtop, laptop) dynamically communicates with each other through wireless medium within their own transmission range (using single hop or multiple hops) via intermediate nodes [1]. The infrastructure less nature of mobile ad hoc network causes frequent change in the topology of network due to dynamic mobility of mobile nodes, communication management, and creation of a stable network are the most challenging tasks in MANET. Clustering is a possible solution to address these existing challenges. With the help of clustering, nodes are organized into different groups that make the network more robust, durable, and scalable [2].

The mobile ad hoc network (MANET) can be deployed without requirement of any further extracost and time. In a MANET, every mobile node plays a role of router along with its job as an ordinary host. MANET still has some challenges like limited bandwidth, limited battery power for each mobile node, and frequent topology changes because of node movement [3, 4]. To list such complex and dynamic environment challenges of mobile ad hoc network, various clustering algorithms have been proposed in the literate [5]. Several routing protocols have been proposed in the literature to handle the one hop and multi-hops, self-organizing network based on proactive, reactive, and hybrid protocols [1]. Routing protocols are categories in three categories which are Proactive, Reactive Active and Hybrid Protocol. Proactive protocol remains activate all the time in network even there is no data to transmit and keeps route information available all the time from source to destination.

Clustering in MANET can be defined as the virtual partitioning of the dynamic nodes into various groups. Groups of the nodes are made with respect to their nearness to other nodes. Two nodes are said to be neighbor of each other when both of them lie within their transmission range and set up a bidirectional link between them.

Clusters in MANET can be categorized as overlapping clusters or non-overlapping clusters as is shown in figure 1. The small circles represent the wireless nodes in the network. The lines joining the nodes denote the connectivity among them. Cluster control structure forms the virtual backbone of communication where cluster heads are the communication hot spots. The cluster head works as the local coordinator for its member nodes and does the resource management among them similar to a base station of cellular architecture. These cluster heads are responsible for inter cluster and intra-cluster communication. Inter cluster communication is made possible through the gateway nodes.

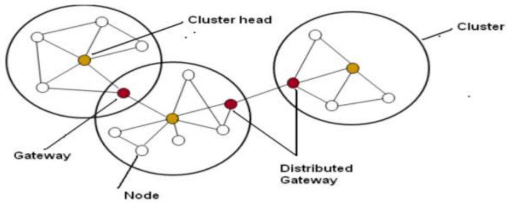

Fig. 1: Overlapping and non-overlapping clusters

The main contributions of this paper are as follows:

- The control information that is exchanged between the source and the destination prior to the actual data transmission.
- In this paperpresents Distributed Weight-based adaptive stable clustering (DWASC) algorithm operates exclusively based on source routing and on-demand process, it has been selected as the routing protocol to be implemented and tested for our ad hoc messenger application characterized by a source on-demand chat conversation between nodes in a mobile ad hoc network.

II. RELATED WORK

In [6] authors discusseda wireless ad-hoc network is a collection of wireless mobile nodes dynamically forming a temporary communication network without the use of any existing infrastructure or centralized administration. It is characterized by both highly dynamic network topology and limited energy. So, the efficiency of MANET depends not only on its control protocol, but also on its topology and energy management. Clustering strategy can improve the performance of flexibility and scalability in the network. With the aid of graph theory, genetic algorithm and simulated annealing hybrid optimization algorithm, this paper proposed a new clustering strategy to perform topology management and energy conservation.

In [7] authors illustrated the time and space varying nature of channel availability among cognitive radio nodes challenges connectivity and robustness of ad-hoc cognitive radio networks. Clustering of neighboring cognitive radio nodes is a suitable approach to address this challenge. A cluster utilizes the same channel for payload communication among the nodes. As a consequence, clustering enables cooperative spectrum sensing, supports a coordinated channel switching and simplifies routing in ad-hoc cognitive radio networks. However, the sudden appearance of primary nodes can lead to the loss of connectivity within a cluster or between clusters.

In [8] authors proposed a Mobile Ad-hoc Network (MANET) is form over wireless media by the various mobile nodes. In other word we can say if various mobile nodes from a network without any infrastructure, such kind of network is known as Mobile Ad-hoc Network. In MANET communication between two mobile devices are performed by routing protocol. In MANET each mobile node can directly communicate with other mobile node if both mobile nodes are within transmission range.

In [9] authors providedthe Communication networks, whether they are wired or wireless, have traditionally been assumed to be connected at least most of the time. However, emerging applications such as emergency response, special operations, smart environments, VANETs, etc. coupled with node heterogeneity and volatile links (e.g. due to wireless propagation phenomena and node mobility) will likely change the typical conditions under which networks operate. In fact, in such scenarios, networks may be mostly disconnected, i.e., most of the time, end-to-end paths connecting every node pair does not exist.

In [10] authors discussed the secure transmission of information in wireless networks without knowledge of eavesdropper channels or locations are considered. Two key mechanisms are employed: artificial noise generation from system nodes other than the transmitter and receiver, and a form of multi-user diversity that allows message reception in the presence of the artificial noise. To determine the maximum number of independently-operating and uniformly distributed eavesdroppers that can be present while the desired secrecy is achieved with high probability in the limit of a large number of system nodes.

In [11] authors proposed an efficient algorithm for minimum energy routing between a source and a destination in the presence of both static and dynamic malicious jammers such that an end-to-end probability of outage is guaranteed. The percentage of energy saved by the proposed method with respect to a shortest path routing benchmark is evaluated. It is shown that the amount of energy saved, especially in terrestrial wireless networks with path-loss exponents greater than two, is substantial.

In [12] authors discussed the information theoretic security has recently emerged as an effective physical layer approach to provide secure communications. The outage performance of such a secrecy communication system is considered in this paper, since it is an important criterion to measure whether users' predefined quality of service can be met. Provided that the legitimate receiver and eavesdropper have the same noise power, many existing secure schemes cannot achieve outage probability approaching zero, regardless of how large the transmission power is. Authors introduced the cooperative transmission into secrecy communication systems, it will be shown here that outage probability approaching zero can be achieved.

III. RESEARCH METHODOLOGY

In this paper, we have proposed a Distributed Weight-based adaptive stable clustering (DWASC) algorithm that allows the detector to verify the honesty of the packet delivery information reported by mobile nodes. The objective of this system is to reduce cluster head changes within cluster to overcome disadvantage of an optimized stable clustering algorithm for mobile ad hoc networks (OSCA) algorithm. A Modified Energy Saving ad hoc has been proposed which will efficiently utilize the battery power of the mobile nodes in such a way that the network will get more life time.The proposed architecture diagram is described in figure 2.

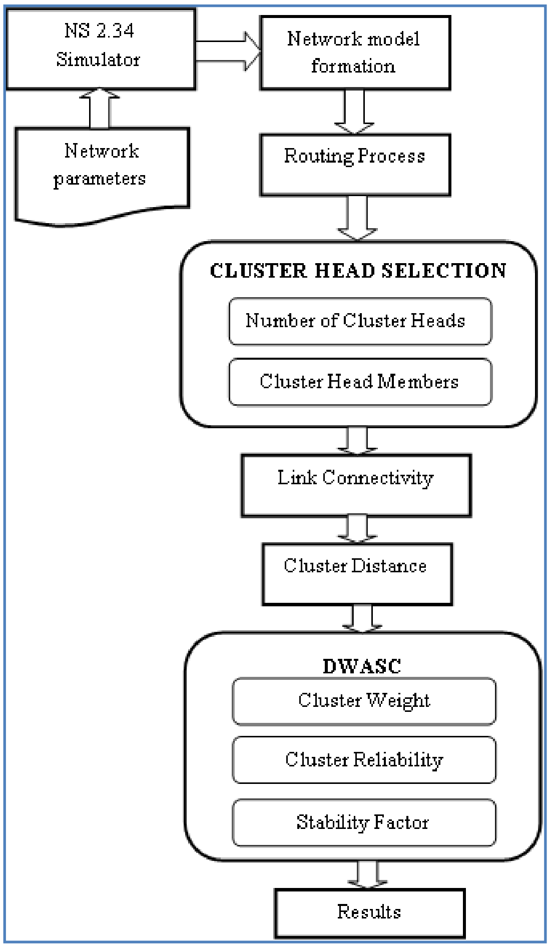

Fig. 2: Proposed Architecture Framework

A. NETWORK MODEL FORMATION

In network model process is evaluated in graph formation. As a graph $G = (N, L)$, where N represents the set of mobile nodes and L represents the group of Links among the nodes. In this model consists of n number of heterogeneous nodes randomly arranged in the simulation environment. Every node has a unique identity (ID) and is prepared with omni-directional projection. It is implicit that nodes are position alert and can compute their qualified distance to their neighboring nodes. Let $P_{max}(k)$ be the maximum transmission power, let $P_{min}(k)$ be the minimum transmission power, and let P_k be the transmission power of a mobile node $k \in L$. To begin with mobile nodes broadcast with maximum power P_{max}.

In this proposed scheme the network model is assumed that transmission power (k) can be regulated linking the maximum and minimum value; that is, $P_{min}(k) \leq P(k) \leq P_{max}(k)$. Let P_{kv} be the minimum transmission power essential to communicate between nodes k and v, which can be calculated as $P_{kv} = Dist^{\beta} + C$, where $Dist$ is the Euclidean distance between k and v, β is the path loss exponent, where $2 \leq \beta \leq 4$, and C is a constant. Let $G = (N, L)$ be the primary topology of the network and let $G' = (N, L')$ be the topology, achieved when the transmission power control method is applied at mobile nodes.

B. ROUTING PROCESS

The routing process is completely on-demand ad hoc network routing protocol composed of two parts: Route Discovery and Route Maintenance.

- Route Discovery to search a path; this node is known as the originator of the Route Discovery, and the destination of the message is recognized as the Discovery's target.
- Route Maintenance is the method by which a node transfer a packet alongside a particular path to various destinations identifies if that path has broken down, for example because two nodes in it have moved moreover separately.

Routing process in mobility clustering is complicated as an end result of the dynamic environment of network topology and the resource conditions. The problem of Link consistency in mobile ad hoc networks is a major problem to broadcast packets throughout the network layouts. Routing process in multi-hop wireless networks via the shortest-path process is not relevant condition to build fine quality routes, because minimum hop count routing frequently selects paths that have extensively less capacity than the best routes that exist in the network.

In detail, information from the transmission links, such as Path Error Rate (PER), can provide important information to the source node about the communication paths as extreme as routing is concerned. Every wireless node can exchange packets with several nodes within its communication range, which depends on PER at the receiver node.

The proposed work present new method will process as follows: When the route request packet arrives at the target node or an in-between node with a route to the target, a route reply packet will be created. This reply packet is subsequently sent back to the source node consequent the reverse route contained in the route request packet. Each intermediate node will update the Path Error Rate (PER) value if its link values of PER lower than the previous recorded values in the route reply packet. If PER value of its link is larger than recorded value, the node will not update the value. The procedure will maintain until the route reply packet achieve the source node. At the present, source node there are many of presented routes with special values of PER. The Source node will choose the route based on the value of top of bad available values of PER.

C. CLUSTER HEAD SELECTION

The cluster head selection (CHS) considers the selection of Cluster heads(CH) in a mobile adhoc network of *n* nodes such that each node in this network is within distance *h* hops of a *CH*, for a given DEFINED-VALUE. In the proposed CHS model, the Cluster duration indicates the time from the position of node is chosen as Cluster head until the position of a node modifies its condition to regular node. It should be noted that the Cluster generation is dependent on mobility problems; the Cluster duration in stable network depends on link reliability. In the simulation model (using NS2.34) a Clustering message is sent every 2 seconds. Thus, a neighbor node is reserved in the neighbor table for 2 ∗*CNT R* seconds and discarded if there is no additional Clustering message received. Primarily, the Statement History (SH) for all mobile nodes has been measured as empty or ≥ 1. Algorithm 4.1 represents the Cluster head(s) selection process as well as a flow chart diagram has been shown in figure 3.

From equation (1) DEFINE-VALUE can be further evaluated by;

$$DV_{ij} = \frac{\sum_{n=i}^{m} DV_{ij}}{SH} \qquad eqn. (1)$$

where $i, j \in$ mobile nodes; DV_{ij} is node *i*'s DEFINED-VALUE for node *j*. Appropriate dynamic changes in the topology of network, the Cluster formation is reorganized from every time to time.

Algorithm 4.1: CLUSTER HEAD SELECTION
Initialize$CH_{cur} \leftarrow 0$; $CH_{prev} \leftarrow 0$; $Time_{prev} \leftarrow 0$;;*Current()*← 0;
Step 1: Time $-OUT_{loop} \leftarrow 2$
Step 2: equation (1) DEFINED-VALUE can be further evaluated

$D_{nij}(t_2) = D_{nij}(t_1) * \exp[-(D_{nij}(t_1)\Delta t)]^{2k}$
where $\Delta t = t_2 - t_1$ and k is an integer such that $k \geq 1$

Step 3:while $Time_{prev} \leq Current()$|| DEFINE – VALUE($CH_{prev}$) ≤ 1 = true **do**
CH_{prev} remains as Cluster head
End while

Step 4:if DEFINE – VALUE(CH_{prev}) = DEFINE – VALUE(CH_{cur}) &&$SH(CH_{pre})$ = SH(CH_{cur}) **then**
Both CH_{prev} and CH_{cur} remain as cluster heads
Else
Choose new Cluster Heads
End if

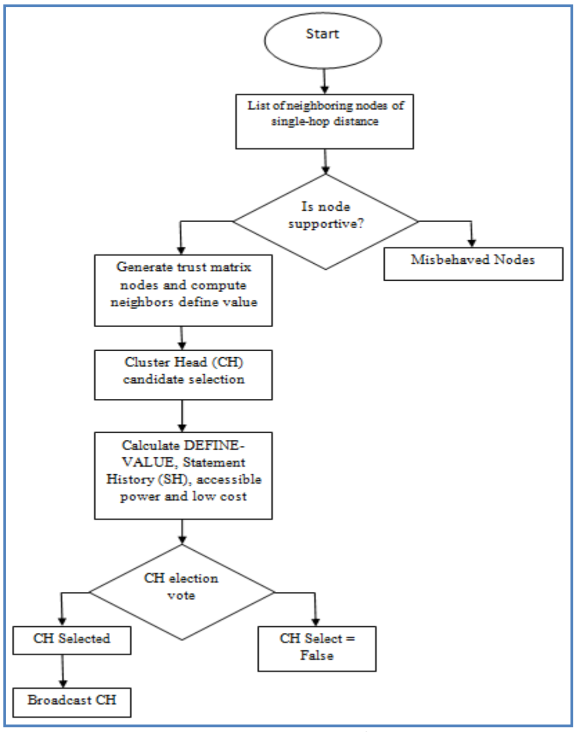

Fig.3: Cluster Head Selection flow diagram

D. DISTRIBUTED WEIGHT-BASED ADAPTIVE STABLE CLUSTERING (DWASC) ALGORITHM

The DWASC in order to prevent early loss due to extreme energy expenses, the entire nodes must be alternately take turns to become CH, and nodes with higher residual energy should have better opportunity to become cluster-head than the nodes with low-energy. CH election need to consider many factors, DWASC use the parameter of likelihood, the information of residual energy in a node and the average residual energy of its neighbor nodes to select, the following factors is considered:

- **Residual energy:** Since the primary energy of every node is the identical, the better the node's remaining energy signify the fewer energy consumed, the additional suitable is selected as the CH to stability the network energy consumption.
- **The time as a CH:** Longer as CH, the faster the energy consumption, all nodes should have a responsibility to share the responsibility of the CH. Therefore, as the CH has less time, more suitable to be selected as cluster head.
- **The number of neighbors:** Neighbor nodes transmit the same number, the more you can reduce the amount of information data transmission energy consumption.

Considering the above three factors, the distributed weight of node w_i can be calculated by the formula:

$$P_{v_i - ch} = a \deg(w_i) + \beta \frac{E_{w_i\_curr}}{E_{w_i\_max}} \quad eqn.(2)$$

Which weight (w_i) state the neighbor number of node w_i; E_{wi_curr} node w_i is the current energy value; E_{wi_max} node w_i is the primary energy value, a lower proportion of nodes energy consumption is precedence to be elected as CH.

IV. SIMULATION RESULTS

The NS 2.34 simulation studies work has been evaluated nearly 51 mobile nodes are taken for simulation process. The proposed system considers 51 nodes in distributed adaptive stable clustering in mobile adhoc network, with nodes randomly deployed in a 300 m x 300 m area. The simulation parameters is given below,

Table 1: Simulation parameters

PARAMETERS	SYMBOL	VALUE
Mobile Nodes	MN	5-50 in steps of 10
Simulation Area	Width x Column	300 x 300
Transmission Range	TR	5-50 in steps of 10
Distributed Weights	D_{w1}, D_{w2}, D_{w3}, …, D_{wn}	(0.1, 0.04, 0.05, 0.2, 0.5)
Node Energy	E_{node}	100Joules
Boosting Energy	E_{boost}	100J/bit/m^2

Energy Packet delivery Ratio (EPDR) the ratio of the data packets delivered to the destinations to those generated by the Constant Bit Rate (CBR) sources. The EPDR shows how successful a protocol performs delivering packets from source to destination. The higher for the value give use the better results shown in figure 3. This metric characterizes both the completeness and correctness of the routing protocol also reliability of routing protocol by giving its effectiveness.

EPDR is the ratio of the number of data packets received by the destination node to the number of data packets sent by the source mobile node. It can be evaluated in terms of percentage (%). This parameter is also called "success rate of the protocols", and is described as follows:

$$\boldsymbol{EPDR} = \left(\frac{\boldsymbol{Amount\ of\ Sending\ \ messages}}{\boldsymbol{Amountof\ Receive\ messages}}\right) \times \mathbf{100}\ \ \boldsymbol{eqn}.(\mathbf{3})$$

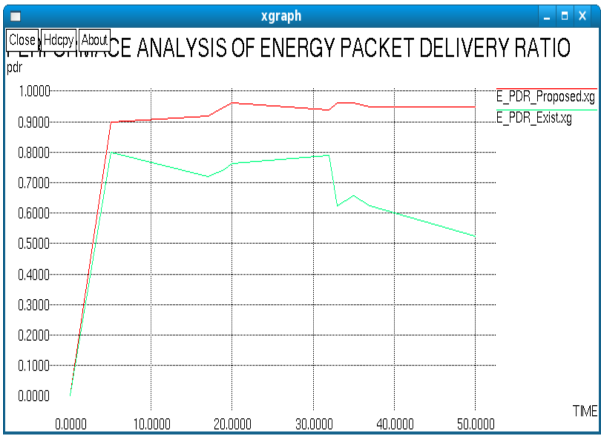

Fig. 4: Performance analysis of EPDR

Energy Throughput: The ratio of the total amount of data that reaches a receiver from a sender to the time it takes for the receiver to get the last packet is referred to as throughput. It is expressed in bits per second or packets per second. Factors that affect throughput include frequent topology changes, unreliable communication, limited bandwidth and limited energy. A high throughput network is desirable. It is the average rate of successful message delivery over a communication channel shown in figure 4. This data may be delivered over a physical or logical link, or pass through a certain network node.

$$\boldsymbol{EX} = \frac{\boldsymbol{Number\ of\ message\ requests}}{\boldsymbol{Total\ Time\ duraiton}}\quad \boldsymbol{eqn}.(\mathbf{4})$$

Where X is the throughput, C is the number of requests that are accomplished by the system, and T denotes the total time of system observation.

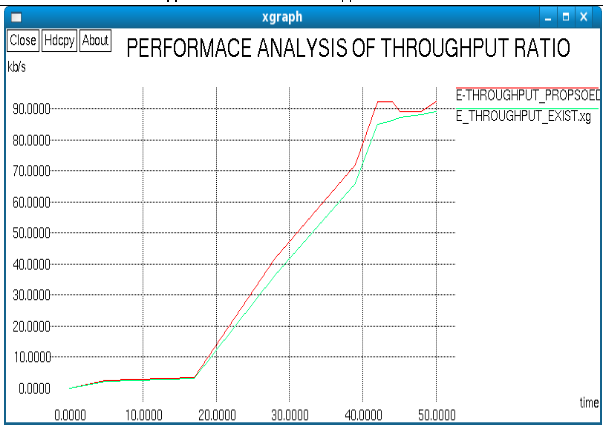

Fig. 5: Performance analysis of Throughput

V. CONCLSUION

In this paper proposed a Distributed Weight-based adaptive stable clustering (DWASC) algorithm in NS (Network Simulator) 2.34 Framework. Each routing path communicates wirelessly with another using the IEEE 802.11b technology without any aid of infrastructure. The main clustering algorithm implemented in this application was the DWASC method, which consists of two important mechanisms, Cluster head formation and Path selection. Since the DWASC protocol operates exclusively based on source routing and on-demand process, it has been selected as the routing protocol to be implemented and tested for our ad hoc messenger application characterized by a source on-demand chat conversation between nodes in a mobile ad hoc network

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