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A MULTI ROUTING ALGORITHM FOR AD-HOC NETWORKS

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ABSTRACT

Ad hoc networks are a new wireless networking paradigm for mobile hosts. Unlike traditional mobile wireless networks, ad hoc networks do not rely on any fixed infrastructure. In this network, this topologies, allowing people and devices to seamlessly internetwork in areas with no pre-existing communication infrastructure, e.g., disaster recovery environments. Each node acting as both a host and a router moves arbitrarily and communicates with others via multiple wireless links. The primary application for ad hoc networks has been for military operations. In this paper we propose new routing algorithms for path energy as an additional metric for routing. The motive behind this effort is to study the effect of the added metric on improving the lifespan of the Ad-Hoc communication network and the corresponding effect on the overall network performance.

Keywords: *Ad-Hoc Networks, Network Routing, Route Discovery.*

1. INTRODUCTION

The proliferation of computing special in mobile computing and communication devices (e.g., cell phones, laptops, handheld digital devices, personal digital assistants, or wearable computers) is driving a revolutionary change in our information society. We are moving from the Personal Computer age (i.e., a one computing device per person by any device) to the Ubiquitous Computing age in which a user utilizes, at the same time, several electronic platforms through which he or she can access to all the required information whenever and wherever needed [16]. The nature of ubiquitous devices makes wireless networks the easiest solution for their interconnection and, as a consequence, the wireless arena has been experiencing exponential growth in the past decade.

Mobile users can use their cellular phone to check e-mail, browse internet; travelers with portable computers can surf the internet from airports, railway stations, Starbucks and other public locations; users can synchronize data and transfer files between portable devices and desktops.

Ad hoc networks are a new paradigm of wireless communication for mobile hosts (which we call nodes). In an ad hoc network, there is no fixed infrastructure such as base stations or mobile switching centers. Mobile nodes that are within each other's radio range communicate directly via wireless links, while those that are far apart rely on other nodes to relay messages as routers. Node mobility in an ad hoc network causes frequent changes of the network topology. Figure 1 shows such an example: initially, nodes A and D have a direct link between them. When D moves out of A's radio range, the link is broken. However, the network is still connected, because A can reach D through C, E, and F [17].

Ad-Hoc network is a collection of wireless mobile nodes without any fixed base station infrastructure and centralized management. Each node acting as both a host and a router moves arbitrarily and communicates with others via multiple wireless links [1]. Therefore, in these networks topology is dynamic and can be change in any time.

Building such ad hoc networks poses a significant technical change because of the many constraints imposed by the environment. Thus, the device used in the field must be lightweight. Furthermore, since they are battery operated, they need to be energy conserving so that battery fife is maximized. Several technologies are being developed to achieve these go by targeting specific components of the computer and optimizing their energy consumption [2] as [3, 4] papers.

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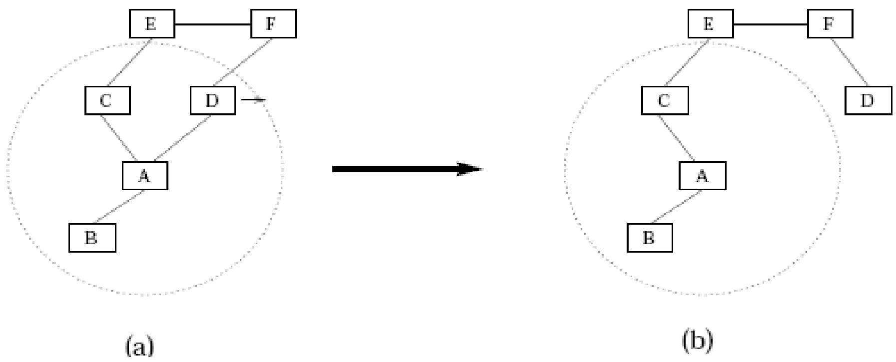

Figure 1. Topology change in ad hoc networks:

The bandwidth of the wireless medium in Ad-hoc networks is less than that of the wired media, routing in mobile ad hoc networks is a challenging research problem. In recent years several routing algorithms [5, 6] have been proposed, but most of these works only focus on routing hops or routing cost instead of providing reliable routes when selecting routes.

The primary application for ad hoc networks has been for military operations. As the military has become more dependent on computer networks, it has sought to develop a resilient, mobile networking architecture to support network-centric warfare [7]. Ad hoc networks have also found use in sensor networks, both civilian and military. In the case of sensor networks, the nodes in the networks are typically fixed rather than mobile. In the civilian sector, mobile ad hoc networks have been proposed for use in collaborative/distributed computing and emergency/disaster recovery operations, as well as in mesh networks and in hybrid wireless network architectures [7].

In this study we want to extend an algorithm as AODV and introduce to new algorithm in ad-hoc networks can use as a model to saving energy on the any node.

Many model related to this algorithm has been implementation and published paper, but in this paper we want to extend other models to new model with better saving energy time. If we can find this model we can use of them and trying to implementation in any ad-hoc networks with lower use of battery.

Remark to location of use ad-hoc networks as networks without any infrastructure [19,20] ex. Earthquake we can't found any power, battery and related energy.

2. LITERATURE SURVEY AND LIMITATION OF EXISTING METHODS

A. *AODV Properties*

The Ad-hoc On-Demand Distance Vector (AODV) routing protocol is designed and implementation for use in ad-hoc mobile networks. AODV is a reactive protocol: the routes are created only when they are needed [18].

It uses traditional routing tables, one entry per destination, and sequence numbers to determine whether routing information is up-to-date and to prevent routing loops [18].

An important feature of AODV is the maintenance of time-based states in each node: a routing entry not recently used is expired. In case of a route is broken the neighbors can be notified.

Route discovery is based on query and reply cycles, and route information is stored in all intermediate nodes along the route in the form of route table entries. The following control packets are used: routing request message (RREQ) is broadcasted by a node requiring a route to another node, routing reply message (RREP) is unicasted back to the source of RREQ, and route error message (RERR) is sent to notify other nodes of the loss of the link. HELLO messages are used for detecting and monitoring links to neighbors [18].

AODV is an on-demand routing protocol. It does not maintain routes for every node to every other node in the network. Whenever a route to the destination is needed, it initiates a route discovery process and the route s remains as long as they are necessary. AODV is loop free at all times (it avoids

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the Bellman-Ford 'Count to infinity' problem), even while repairing broken links [Perkins+ 1999] which offers quick convergence when the ad-hoc network topology changes. This loop freedom is accomplished through the use of sequence numbers. Each node maintains its own monotonically increasing sequence number, which increases each time it learns of a topology change of its neighborhood. Beside loop freedom, the use of the sequence number assures that the most recent route is selected whenever a route discovery is initiated. In addition, each multicast group has its own sequence number, which is maintained by the multicast group leader.

AODV is able to provide uncast, multicast and broadcast communication ability. Combining all three communication forms in a single protocol has numerous advantages.

AODV is capable of operating on both wired and wireless media, although it is specifically designed for the wireless domain.

B. AODV Algorithm

When the local connectivity of the mobile node is of interest, each mobile node can become aware of the other nodes in its neighborhood by the use of several techniques, including local broadcasts known as hello messages. The routing tables of the nodes within the neighborhood are organized to optimize response time to local movements and provide quick response time for requests for establishment of new routes AODV uses a broadcast route discovery mechanism as is also used (with modifications) in the Dynamic Source Routing (DSR) algorithm. Instead of source routing, however, AODV relies on dynamically establishing route table entries at intermediate nodes. This difference pays off in networks with many nodes, where a larger overhead is incurred by carrying source routes in each data packet. To maintain the most recent routing information between nodes, the same concept of destination sequence numbers from DSDV is used. Unlike in DSDV, however, each ad-hoc node maintains a monotonically increasing sequence number counter which is used to supersede stale cached routes. The combination of these techniques yields an algorithm that uses bandwidth efficiently (by minimizing the network load for control and data traffic), is responsive to changes in topology, and ensures loop-free routing [8, 13].

- ***Proactive Protocols***

With a proactive protocol, each node maintains one or more tables containing routing information to every other node in the network. All nodes update these tables so as to maintain a consistent and up-to-date view of the network. When the network topology changes, the nodes propagate update messages throughout the network to update the tables. These protocols differ in the method by which the topology change information is distributed across the network, and the number of routing tables that are required [9].

- ***Reactive Protocols***

In contrast to table-driven routing protocols, reactive protocols do not maintain up-to-date routing tables at the nodes; instead the routes are created as and when required.

When a source wants to send to a destination, it invokes a route discovery mechanism to find a suitable path to the destination. The route remains valid until the destination is unreachable or until the route is no longer needed. These protocols differ in the way route discovery and route maintenance is done [9].

C. Rout Discovery

When a node needs to send a packet to a destination to which it does not have a routing entry, it broadcasts a route request (RREQ) packet. To prevent unnecessary broadcasts of RREQs the source node uses an expanding ring search.[8,14,15]

In an expanding ring search, the source node initially uses a time-to-live (TTL)-Start in the RREQ packet IP header and sets a timeout for receiving a reply (RREP). Upon timeout the source retransmits a RREQ with TTL incremented by TTL-increment. This continues until TTL reaches a specified maximum. The source will retransmit the RREQ with the highest TTL if it does not receive any reply within the timeout period. A node receiving a RREQ establishes a reverse path to the RREQ source in its routing table, and either replies to the RREQ if it already has an entry for the destination or forwards the RREQ. Eventually the RREQ reaches the destination and it sends a reply (RREP). Nodes receiving a RREP set up a path to the destination and, in this way, desirable routes are discovered [10, 11].

D. Rout Maintenance

An existing routing entry may be invalidated if it is unused within a specified time interval, or if the next hop node is no longer reachable. In these cases, an invalidation notice is propagated to neighbors that have used this node as the next hop.

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Each time a route is used to forward a data packet, its route expiry time is updated. When a node detects that a route to a neighbor is no longer valid, it removes the invalid entry and sends a route error message to the neighbors that are using the route. The nodes receiving route error messages repeat this procedure. Finally, the source requests a new route if a route is still needed to that destination [10, 11].

3. THEN NEWLY PROPOSED METHOD

a. Routing Algorithm

If any path can be deliver and receive information to destination node then this path mark as reliable routing. In this section we introduce a method for finding a set of multi routing in Ad-Hoc networks who has good enough information as energy saving in this path, then method will be select some nodes in any path and union of all item possible in the network.

In this paper we proposed a new method that compose of clustering path recognize by K-means algorithm and after that AODV algorithm used as finding best routing on the every clusters.

K-means algorithm is a clustering algorithm in large network.

The iterative algorithm for solving is as follows[12]:

K-means algorithm:

Step 1: Have an arbitrary assignment C of points into the specified number of clusters K (initialization can be done by assigning the ith point to the i mod K cluster). Compute the mean vector for each cluster.

Step 2: For the given assignment C, the cluster variance as expressed in is minimized with respect to {m1,…,mK} yielding the means of the currently assigned clusters.

Step 3: Given a current assignment of means {m1,…,mK}, is minimized by assigning each point to the closest cluster mean. That is,

$$C(i) = \arg\min_{1 \le k \le K} \left\| x_i - m_k \right\|^2$$

Step 4: Iterate step 2 and 3 until the cluster memberships do not change.

As illustrated in figure 3, after K-means algorithm running, with k equal 4 dived sections, then we can found 3 clusters in sample network.

Now we have many nodes or one node in any clusters, if a node deposit or outland of any cluster in this network, then we have other nodes can be held and replacement of this.

After clustering we have a source and destination node. Now we must be finding all routing from source to destination, all routing from or to a cluster mark as a node.

Now, we must be running AODV algorithm on the clusters for finding all routing on the network from source to destination.

Figure 2: K-mean algorithm

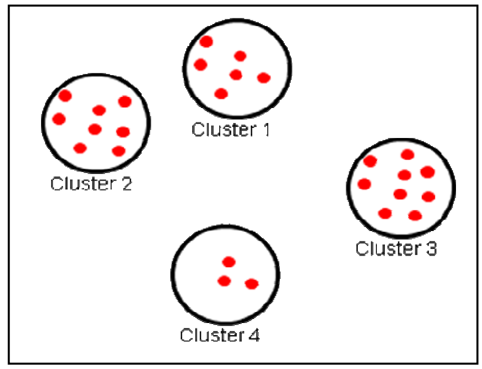
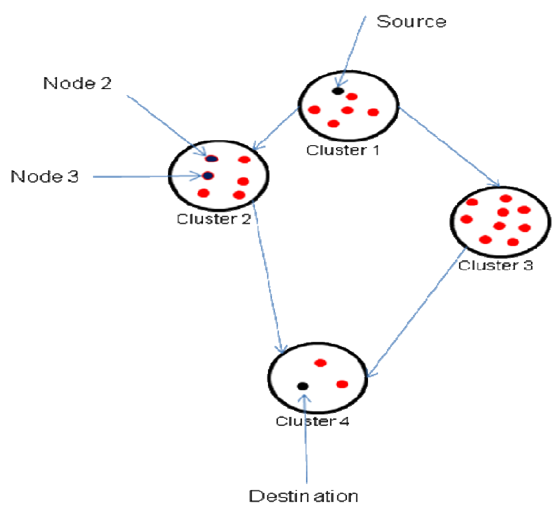


Figure 3: After K-means running on the network



4. METHODOLOGY

E. What effect does any clusters Ad-Hoc operations have on power consumption?

IEEE 802.11 defines two primary modes of operation for a wireless network interface: base station (BSS) mode and ad hoc mode. Every mobile host operating in BSS mode must be in transmission range of one or more base stations, which are responsible for buffering and forwarding traffic between hosts.

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Hosts can send outgoing traffic to the base station anytime and periodically poll the base station to receive incoming traffic.

The remainder of the time is spent in a sleep state, from which the interface must explicitly wake up in order to send or receive traffic. The base stations' guaranteed availability and buffering and traffic management capabilities are required to support this energy conserving functionality.

Ad hoc mode operation does not use any base station infrastructure: nodes communicate directly with all other nodes in any clusters that are in wireless transmission range. Because there are no base stations to moderate communication, hosts must always be ready to receive traffic from their neighbors. A network interface operating in ad hoc mode does not sleep; it has a constant idle power consumption which reflects the cost of listening to the wireless channel. This cost, which has been measured, but is not described in device specifications, is only slightly less than that of actually receiving traffic.

F. How can we model per-packet energy consumption in all clusters?

In the simple case, the energy consumed by the network interface when a host sends, receives or discards a packet can be described using a linear equation

$$Energy = m * Size + b$$

Trivially, there is a fixed component associated with device state changes and channel acquisition overhead and an incremental component which is proportional to the size of the packet. Experimental results confirm the accuracy of the linear model and are used to determine values for the linear coefficients for various operations.

If we want to find better path in this network, we mark all nodes with 4 sections:

$(P_k, E_k, IRS(P_k), Clu(P_k))$

That P_k is k^{th} node, E_k is remaining of energy node, IRS (P_k) is list of direct reachable nodes and $Clu(P_k)$ is number of cluster assigned by K-means.

For example figure 4 shown how to clusters assigned after K-means running on the network.

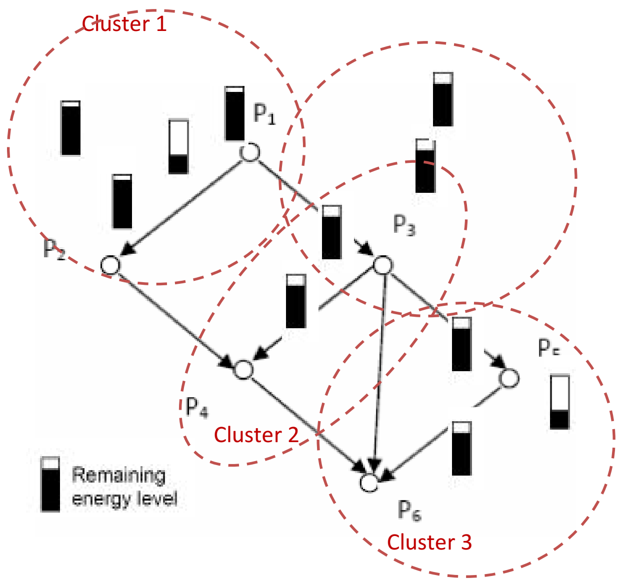

Figure 4: clustering and energy level of nodes

In this model any node has a GPS system for detect location and send their location to all neighborhood nodes as $IRS(P_k)$ section. In table 1, shown how any node has 4 section of information about neighborhood and energy level.

Table 1: list of nodes data information

Node P_i	E_k	$IRS(P_k)$	$Clu(P_k)$
P_1	E_2,E_3	$\{P_2 P_3\}$	1
P_2	E_4	$\{P_4\}$	1
P_3	E_6,E_5	$\{P_6,P_5\}$	2
P_4	E_6	$\{P_6\}$	2
P_5	E_6	$\{P_6\}$	3
P_6	0	{Ǿ}	3

Now suppose that all nodes has good enough energy, after that find a tree by source to destination, in this tree structure any leaf is a destination and any branch is a routing form source node to destination node.

The direct consequence of using unreliable route is that routes will be broken frequently. In order to rebuild routes after routes broken, existing routing algorithms usually deposit the outgoing packets in the buffer, and packets will be dropped if buffer overflowed. Hence, frequent routes breaking will badly affect the utilization and throughput of ad hoc networks. For the reason that existing routing algorithms do not provide reliability, we propose a reliable routing algorithm to tackle the routing reliability problem by clustering.

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5. CONCLUSION AND FUTURE WORK

As study in this paper we found an extended algorithm as AODV category and introduce to new algorithm in ad-hoc networks can use as a model to saving energy. Many model related to this algorithm has been implementation and published but in this paper we extend and get better answer vs. other models, then in this algorithm we have better saving energy time. If we can find this model we can use of them and trying to implementation in any ad-hoc networks with lower use of battery.

The simulation is conducted for 60 nodes. There are 6 active source-destination connections between the 10 nodes.

The results shown in figure 6, that our proposed algorithm performs better that other existing model at high pause times (900 seconds) and many kind of network size. At these pause times our model has a lower routing load, lower delay, and better packet delivery fraction although it's performance degrades at stationary state. Other output of this algorithm is shown on the figure 7, in this figure shown if we can use of this model we can have better performance in clustering of any objects in this network.

This proposed routing criterion is certainly not the ultimate solution to improve the robustness in ad-hoc networks neither improve the network load distribution nor power management. We will be pursuing our research in our future work to combine our route clustering method with the multipath AODV. We are studying also how we can use the energy information to determine route freshness beside its use in the route clusters.

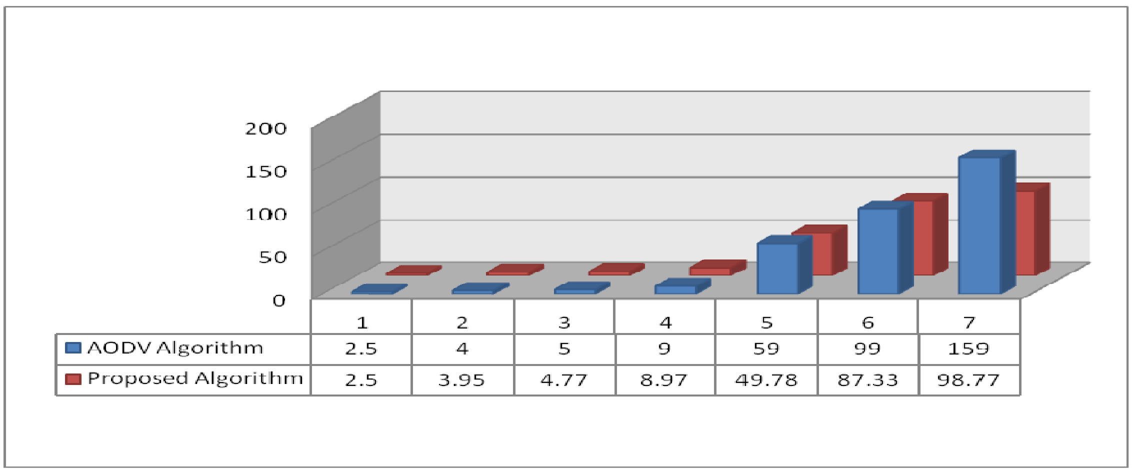

Figure 6. Result of Proposed algorithms vs. AODV

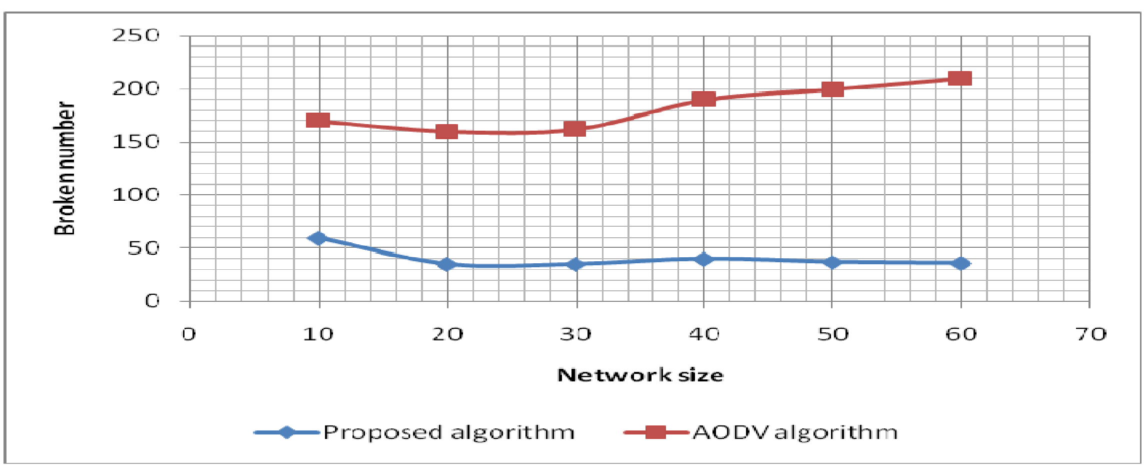

Figure 7. Result of clustering in proposed algorithms vs. AODV

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