Packet Collision Avoidance in Energy Efficient CC-MANETs

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***Abstract*—Content centric network (CCN) totally transform the host centric network architecture to content centric network architecture. Different researchers studied CCN for Mobile ad hoc networks (MANETs) for efficient communication. MANET in CCN faces various issues of flooding of interest packet and data packets, broadcasting on broken edges, power consumption, and reestablishment of the connection with mobile nodes. In this paper, we proposed an efficient multicasting and collision avoidance (EMCA) protocol in content centric MANETs (CCMANETs). It minimizes the interest packet and data packet flooding in the network by applying check on the content store (CS) and pending interest table (PIT). EMCA also maintains the unique routing table (RT) at each node. RT extracts information from interest packets. If the path breaks during the data packet unicasting then data packet custodian node uses RT entries to select the second best path for unicasting. The simulation results of EMCA shows better results than AIRDrop because AIRDrop uses broadcasting on broken edges. EMCA achieves high throughput with less network load and minimum battery consumption. It also minimizes packet flooding in the network to ensure less packet collision rate. EMCA provides better content based communication protocol and ensures more successful communication in dynamic topology. In this project, we present an efficient multicasting and collision avoidance (EMCA) protocol in content centric MANETs (CCMANETs). Our proposal is based on a tone system to provide more efficiency and better performance. The protocol consists of a new construction method for mobile nodes using a clustering approach that depends on distance and remaining energy to provide more stability and to reduce energy consumption. In addition, we propose an adjustment to the typical multicast flow by adding unicast links between clusters.**

Keywords—AIRDrop, MANETs, Clustering.

I. INTRODUCTION

Mobile Ad Hoc Networks (MANETs) are comprised of mobile nodes in a dynamic environment. Mobile nodes are infrastructure less and can change the position in various directions. During the communication, mobile nodes also act as a router and can send or receive data from nodes. They can be used for various purposes like a battlefield, emergency, disaster etc. But MANETs have the issue of battery drainage, broken edges, assigning an IP address to new nodes and reestablishment of the network.

Internet assigns unique IP addresses to each device and satisfies each request through the specific server. Current Internet architecture ensures end-to-end connectivity during the whole communication process. But now the user is more interested in content instead of end-to-end connectivity. Current Internet architecture has issues of mobility, heterogeneity of network, heterogeneity of data and scalability.

Ad hoc networking with the advantages of fast deployment 48 and easy device replacement has drawn more and more attention, which can provide various services such as communication, storage, and computing for a range of applications. Mobile ad 51 hoc networks (MANET) can be used in rural or emergency scenarios that lack of infrastructure coverage. Since the MANET 53 is self-organized, the wireless nodes may join and quit the net- 54 work randomly; thus, the communication connectivity is short- 55 lived, and the network topology formed with the short-lived 56 links varies dynamically. In such kind of networks, when nodes 57 are moving out of the network, the contents may vanish if the 58 contents are delivered based on TCP/IP but can still remain in 59 CCN-based networks.

Due to above mention issues researchers proposed Content Centric Networking (CCN), a unique content name based Internet architecture, which ensures communication through the unique name of content rather than IP address [1]. CCN maintains three types of table forward information base (FIB) pending interest table (PIT) and content store (CS).

Node store data in its cache and keep its record in CS. Request broadcasted in interest packet and response sends the provider in the data packet. Consumer broadcasts the interest packet, a relay node receives interest packet checks its CS if content not found in CS then PIT entry is maintained and forwards the interest packet to another node according to FIB.

Currently, various researchers are working on different domains of CCN like security, privacy, trust, naming, routing and caching. We particularly focus on routing in CCN. Various researchers proposed and implemented different CCN based routing protocols. Some of them provide energy efficiency while others are providing routing efficiency. Some research papers provide both strategies [2] but use broadcasting on broken edges which consume high power as a number of nodes grow in the network.

Due to above-mentioned issues, we proposed a unique content centric Mobile Ad Hoc Network (CC-MANETs) based efficient multicasting and collision avoidance (EMCA) protocol. By eliminating the broadcasting on broken edges, it minimizes the collision probability of transmitted data packet in large networks. Multiple consumers transmit the interest packets and their requests are satisfied by the multiple providers. By using the proposed mobility control algorithm of EMCA, it handles the broken edges and minimizes the interest packet and data packet transmission in the network.

II. RELATED WORKS

In this section, the most relevant research contributions of various researchers are summarized. [1]HUANG Tao, LI Jiangxu and LIU Jiang proposed, Mobility support for content source in CCN that has the existing CCN mobility mechanisms which are transplanted from the IP mobility solutions that are unnaturally integrated with CCN. By considering previous works, a mobility strategy from the perspective of CCN architecture is proposed to support the handoff of MCS in this paper. Especially, they defined the critical network routers that can limit the routing update scale effectively when MCS handoff was conducted. Based on the defined critical network routers, the proposed scheme can provide lower routing update overhead, where faster routing convergence and shorter service interruption time.

Besides, the basic CCN does not support MCS handoff because the handoff will permanently hide MCS from user. The future work was focused on some mobility scenarios such as the MCS is rapidly changing its access point or many MCSs perform handoff from one access point to another at that time. To assess the performance they proposed scheme in those challenging situations or propose other new strategies would be interesting.

Jian Kuang and Shun-Zheng Yu proposed, "**CSAR: A Content-Scent based Architecture for Information-Centric mobile ad hoc networks**" [2]. Where each content has its special content-scent and can be found by tracing the scent spreads over the networks. The content-scent has the property similar to the natural scent that can spread over air, mix with other scents, decay with distance and time, and strengthen with fresh supplement. Using this property, scent-based routing and reliable content delivery functionalities are provided for the mobile ad hoc environment. The Simulation results show that CSAR has an efficient route discovery procedure with less routing overhead and better in-network caching for the mobile ad hoc networks.

By this architecture, the content-scent is defined and mapped from the content name, which can be stored in the compact data structure called scent table. They have experimentally evaluated CSAR and compared it to the ECHANET and AODV where the simulation results out performs those MANET solutions across different metrics.

Zejun Xu, Zhou Su, Qichao Xu and Qifan Qi proposed, "**Delivering mobile social content with selective agent and relay nodes in content centric networks**" [3], the content centric based mobile social networks have a huge number of interest packets that needs to be forwarded. Besides, the selection of forwarding node and relay node are important to deliver the content to the destination. Therefore at present the detailed methods to select the agent node and the relay node. Then, the priorities are defined to forward the interest packets and provide the corresponding data packets, respectively. The simulation experiments prove that the proposal can reduce the delay to obtain content more efficiently than other conventional methods.

The priorities to forward the interest packets with the agent node and transmit the data packets with relay node have been defined where the simulation results have been shown that their proposals can be efficiently deliver the content in content centric mobile social network. The analysis of the information spreading and network model has not been considered.

Giovanna Carofiglio and Massimo Gallo proposed, "**Optimal multipath congestion control and request forwarding in information-centric networks**" [4], the decomposition of optimal congestion control strategies at receiver have distributed algorithms for dynamic request of forwarding the network nodes. By experimental evaluation of their proposal they have carried out in different networking scenarios using the realistic workloads, such that the performance of the design benefits the ICN approach.

The problem of a joint multipath congestion control and request forwarding in ICN is distributed and the interworking mechanism for the point-to-multipoint is delivered. The global optimization problem with the objective of maximizing end-user throughput by minimizing the network cost.

MarouaMeddeba and Amine Dhraief proposed, "**Producer mobility support in named data internet of things network**" [5], the Named-Data Networking (NDN) is a promising candidate for the Internet of Things (IoT) targeted the improve data dissemination efficiency. This new paradigm brings considerable benefits such as minimizing the content producer solicitation and rapid data transmission. The producer mobility issue in NDN is not sufficiently addressed. Especially, in IoT scenario, in which the devices are frequently mobile and it requires data to keep continuity. In this paper,they have proposed producer mobility solutions in NDN in an IoT context.

The NDN have natively supports consumer mobility, where the mobility producer issueshave been addressed. In addition, lots of application as in IoTsystems also requires a

non-resourcecostly mobility support approach while minimizing the handoff latency and the overheard in the network. Hence they focused on producer mobility in NDN IoT and we present and discuss several studies. For future work, we aim to propose a novel name-based routing protocol that handles producer mobility.

HaoJin, Dan Xu, Chenglin Zhao and Dong Liang, "**Information-centric mobile caching network frameworks and caching optimization: a survey**" [6], Information on centric mobile caching network architectures have emerged in Information-Centric Networking as well as mobile cellular and ad-hoc networks deployed with caches. The Caching optimization based on information centric mobile caching and has several significant research challenges remain to be addressed before its widespread adoption. In this paper, a brief survey on Information centric mobile caching network architecture and caching optimization is presented, including cache placement in different mobile wireless network architectures, the taxonomy of cache insertion and eviction policies, the modeling behavior of caching networks as well as caching optimization based on network centric and user centric metrics, and typical applications based on mobile caching.

III. METHODOLOGY

System Model 1

We make some assumptions about the sensor nodes and the underlying network model:

Considering a base station (i.e., data sink) which is a mobile.

Sensors are all stationary after deployment.

All sensors can adjust their power transmission based on the distance with respect to the base station.

All nodes are homogeneous (i.e. the same energy resources).

Proposed Algorithm-1

In hierarchical routing algorithms, cluster heads are responsible for gathering, compressing and forwarding the data to the base station. Thus, they will become exhausted very soon if the load remains on them. In the proposed algorithm, the strategy is to manage the base station movements in each round so that it can approach to a specific cluster heads and reduce the cluster head's load in the sense of energy consumption.

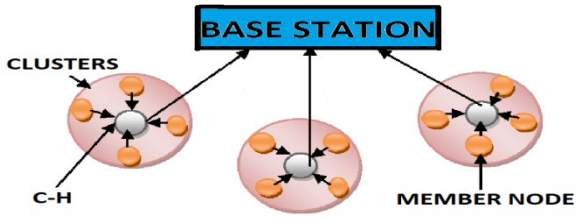

Figure.1. View of clustering of nodes.

After organizing the nodes into the clusters and at the beginning of each round, the cluster heads report their status (such as location, number of members and energy) to the base station via a single packet called "Status Packet". At this point, base station must decide to whichcluster head it should approach. In other words, base station must determine the most critical-status ofcluster head and then approach to it. Based on the received information from cluster heads, the base station is able to determine the distance to the cluster heads.

Decision making is performed by a fuzzy system at the base station. Therefore, we define a fuzzy system with three parameters as inputs:

1) Cluster head's residual energy: The less energy the cluster head has, the more critical-status cluster head it is.

2) Proximity to base station: The more distant the cluster head is from the base station, the more energy is required for data communications, and consequently the more critical-status cluster head it is.

3) Number of members in the cluster: The more members in the cluster, the more data gathering/processing/forwarding is required and thus the more critical-status cluster head it is.

We used proximity to base station and number of members for determining Critical degree, because these parameters play important role to consume energy of cluster heads. The if-then fuzzy rule base is also shown in Table.

After assigning a Critical Degree to each cluster head, the base station determines the most critical-status of the cluster head and moves towards it. If two or more cluster head have the same Critical Degree, base station randomly select one of them. The movements of the base station are limited to a predefined step size. After cluster formation in each round and receiving all status packets, the base station determines its new location and move towards it. Situating in the position, the base station broadcasts the location across the network, so that cluster heads would know it. Now, cluster heads can adjust their power control according to their proximity to the base station and send their data to it.

The fuzzy system consists of a fuzzifier, fuzzy rules, fuzzy inference engine and a defuzzifier. We used Mamdani method for fuzzy inference technique and center averaging for defuzzification.

The membership functions of cluster head's residual energy, Proximity to base station and number of members in the cluster depend on initial energy, the position of base station and the network's density respectively. The maximum range of membership functions are determined by maximum values of input parameters. Maximum value of Proximity to base station parameter can be derived as below,

$$\boldsymbol{MPBS} = \sqrt{\boldsymbol{x_{bs}^2} + \boldsymbol{y_{bs}^2}} \rightarrow (1)$$

Where (x_{bs}, y_{bs}) is the position of base station. Maximum values of energy and cluster members are initial energy and total nodes minus one node as cluster head respectively.

Proposed Algorithm-2

Node caching Ad-Hoc On-Demand Distance Vector (AODV-NC) technique caches the nodes which have recentlyforwarded the data packets and uses only these selected neighbors for forwarding the Router request packets. Route request uses a fixed threshold parameter H and Routing Table. The first route request is sent with the small threshold H and destination address of node N from Table. When a node N receives the route request, it compares the current time T with the time T(N) when the last data packet through N has been forwarded.

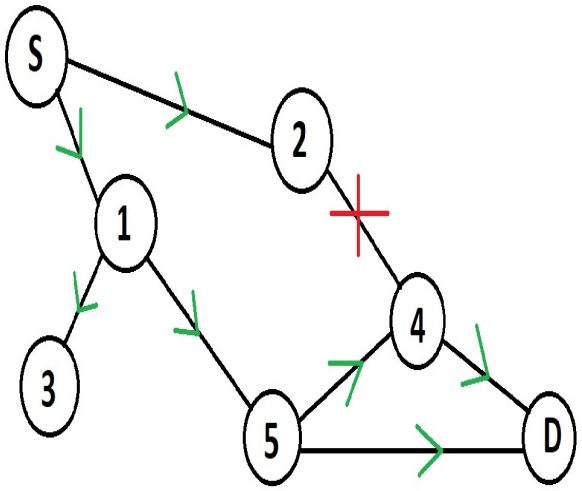

Figure.2. Data transfer through nodes without broken edges.

If T - H >T(N), then N does not belong to the current node cache and, therefore, N will not propagate the route request. Otherwise, if T - H = T (N), then N is in the node cache and the route request is propagated as usual. Of course, the node cache cannot guarantee existence of paths between all source-destination pairs;therefore, if the route request with the small threshold H fails to find a route to destination, then a standard route request is generated at the source.

In the default settings of AODV, if the route to the destination is broken, obsolete or unestablished, the route request originated from the source is propagated through the entireMANET. If the route reply is not received by the source in a certain period of time, then the route request is periodically repeated. If all these Route Requests happened to be unsuccessful, several more requests with increasing time gaps are sent. In AODV-NC, modifications are restricted solely to the Route Request and its initiation.

IV. IMPLEMENTATION

a) Flow Chart

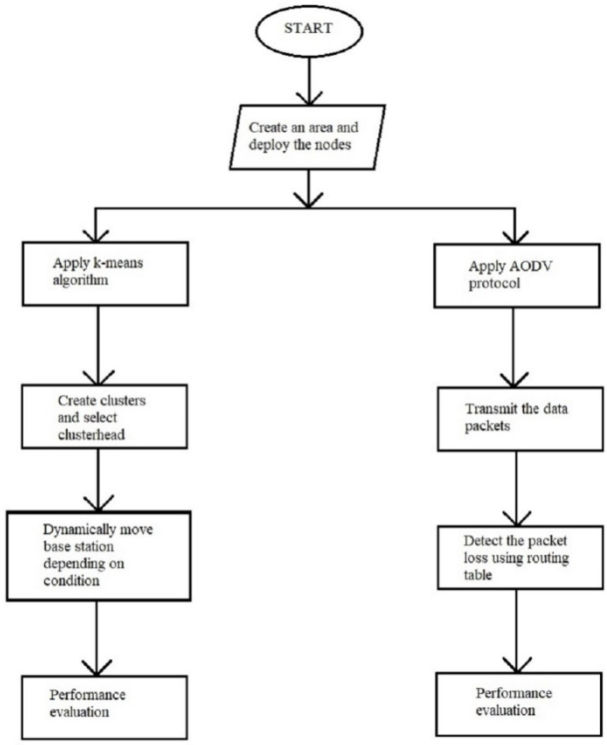

Figure.3. Flow chart of the proposed system.

The flowchart describes program where initially the assigning of nodes are done, then the nodes deployed into an area where the nodes are clustered using the k-means algorithm for clustering. K-means algorithm is used for clustering of the nodes is done in this clustering the N nodes are done by taking the mean of their distance. Then we appoint a cluster head for each cluster which will be communicating with the base station. Where to increase the life time of the network we are going to move the base station and it will be moved according to the energy of each cluster. In a cluster we are going to assign separate energy levels to communicate with the cluster head and the cluster head is communicated with the base station. Then to send the data packet without breakage we are using routing tables for sending the data from source to destination without breakage. AODV is a routing protocol designed for using in mobile ad hoc networks. As a routing protocol for mobile ad hoc network it is intended to accommodate networks that are as large as several numbers of nodes. Addressing is done through handling of IP addresses. This protocol is invoked only when a node or source has the data to transfer. It is a reactive protocol.

b) Software

MATLAB is a multi-paradigm numerical computing environment and proprietary programming language developed by MathWorks. The version of the software which we are using for this method is MATLAB R2013a.

The basic features of MATLAB −

- It is a high-level language for numerical computation, visualization and application development.
- It also provides an interactive environment for iterative exploration, design and problem solving.
- It provides vast library of mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, numerical integration and solving ordinary differential equations.
- It provides built-in graphics for visualizing data and tools for creating custom plots.
- MATLAB's programming interface gives development tools for improving code quality maintainability and maximizing performance.
- It provides tools for building applications with custom graphical interfaces.
- It provides functions for integrating MATLAB based algorithms with external applications and languages such as C, Java, .NET and Microsoft Excel.

V. SIMULATION RESULTS

Performance analysis-1

Leach is a less energy adaptive clustering hierarchy **protocol**. The main goal of cluster based sensor networks is to decrease system delay and reduce energy consumption. Leach is a cluster based protocol for micro sensor networks which achieves energy efficient, scalable routing and fair media access for sensor nodes.

Leach is a hierarchical protocol in which most nodes transmit to cluster heads, and the cluster heads aggregate and compress the data and forward it to the base station (sink). Each node uses a stochastic algorithm at each round to determine whether it will become a cluster head in this round. LEACH assumes that each node has a radio powerful enough to directly reach the base station or the nearest cluster head, but that using this radio at full power all the time would waste energy.

Nodes that have been cluster heads cannot become cluster heads again for P rounds, where P is the desired percentage of cluster heads. Thereafter, each node has a $1/P$ probability of becoming a cluster head again. At the end of each round, each node that is not a cluster head selects the closest cluster head and joins that cluster. The cluster head then creates a schedule for each node in its cluster to transmit its data.

All nodes that are not cluster heads only communicate with the cluster head in a TDMA fashion, according to the schedule created by the cluster head. They do so using the minimum energy needed to reach the cluster head, and only need to keep their radios on during their time slot.

LEACH also uses CDMA so that each cluster uses a different set of CDMA codes, to minimize interference between clusters.

Properties of this algorithm include:

- Cluster based
- Random cluster head selection each round with rotation. Or cluster head selection based on sensor having highest energy
- Cluster membership adaptive
- Data aggregation at cluster head
- Cluster head communicate directly with sink or user
- Communication done with cluster head via TDMA
- Threshold value

There are many both open-source and commercial network simulators for LEACH such as

1. ns (open source)
2. OPNET (proprietary software)
3. NetSim (proprietary software)
4. OMNeT++ (IDE)
5. TinyOS (open source)
6. MATLAB
7. contiki (open source)

Stable Election Protocol: The impact of heterogeneity of nodes, in terms of their energy, in wireless sensor networks that are hierarchically clustered. In these networks some of the nodes become cluster heads, aggregate the data of their cluster members and transmit it to the sink. We assume that a percentage of the population of sensor nodes is equipped with additional energy resources—this is a source of heterogeneity which may result from the initial setting or as the operation of the network evolves. We also assume that the sensors are randomly (uniformly) distributed and are not mobile, the coordinates of the sink and the dimensions of the sensor field are known. We show that the behavior of such sensor networks becomes very unstable once the first node dies, especially in the presence of node heterogeneity.

Classical clustering protocols assume that all the nodes are equipped with the same amount of energy and as a result, they cannot take full advantage of the presence of node heterogeneity. We propose SEP, a heterogeneous-aware protocol to prolong the time interval before the death of the first node (we refer to as stability period), which is crucial for many applications where the feedback from the sensor network must be reliable. SEP is based on weighted election

probabilities of each node to become cluster head according to the remaining energy in each node.

We show by simulation that SEP always prolongs the stability period compared to (and that the average throughput is greater than) the one obtained using current clustering protocols. We conclude by studying the sensitivity of our SEP protocol to heterogeneity parameters capturing energy imbalance in the network. We found that SEP yields longer stability region for higher values of extra energy brought by more powerful nodes.

DEEC: Distributed energy efficient clustering Criteria for cluster head election Cluster-heads are elected by a probability based on the ratio between residual energy of each node and the average energy of the network. The epochs of being cluster-heads for nodes are different according to their initial and residual energy. Nodes with high initial and residual energy will have more chances to be the cluster-heads than the nodes with low energy. DEEC achieves longer lifetime and more effective messages than current important clustering protocols in heterogeneous environments.

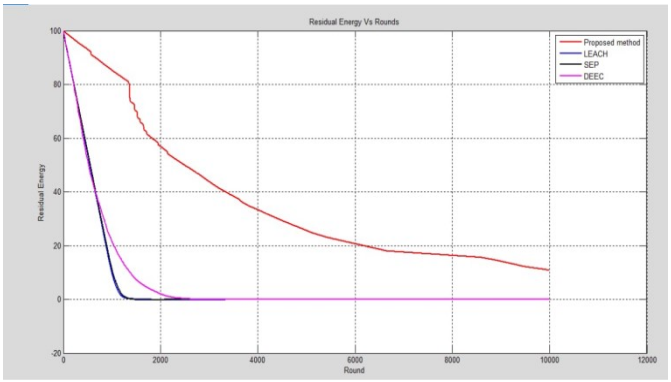

Figure.4. Comparison of energy levels with different protocols.

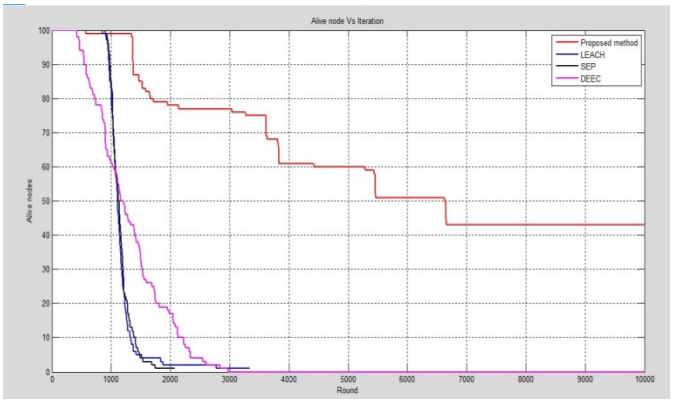

Figure.5. Comparison of alive nodes of the proposed system with other systems.

From the above figure we can see that the performance of the proposed system will be more when compared to the other protocols like leach, sep and deec. The figure 4 shows energy used by the proposed system is very less when compared to the other systems. The figure 5 describes the number of alivenodes after the total number of iterations completed. The figure 6 is the simulation output of the first part of the objective as mentioned above. This shows that the energy of the nodes is saved and the network life time is maintained for longer duration in the wsn area.

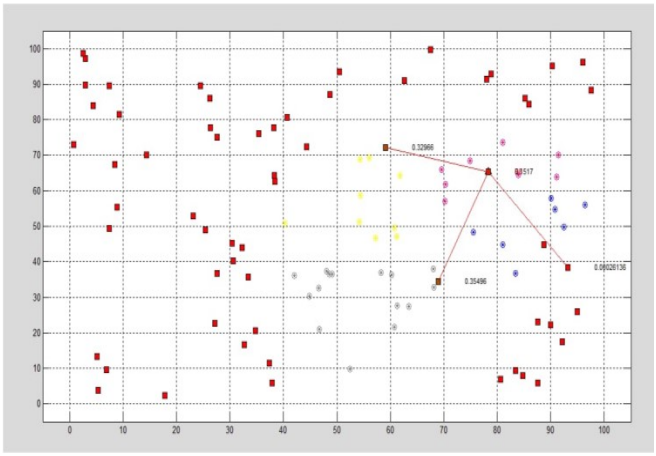

Figure .6.Simulation Output view-1

Performance analysis-2

Node caching AODV (AODV-NC) technique caches the nodes which have recently forwarded the data packets and uses only these selected neighbors for forwarding the Route request packets. Route request uses a fixed threshold parameter H and Routing Table. The first route request is sent with the small threshold H and destination address of node N from Table. When a node N receives the route request, it compares the current time T with the time T (N) when the last data packet through N has been forwarded. If T - H >T(N), then N does not belong to the current node cache and, therefore, N will not propagate the route request. Otherwise, if T - H _ T (N), then N is in the node cache and the route request is propagated as usual. Of course, the node cache cannot guarantee existence of paths between all source-destination pairs, therefore, if the route request with the small threshold H fails to find a route to destination, then a standard route request is generated at the source.

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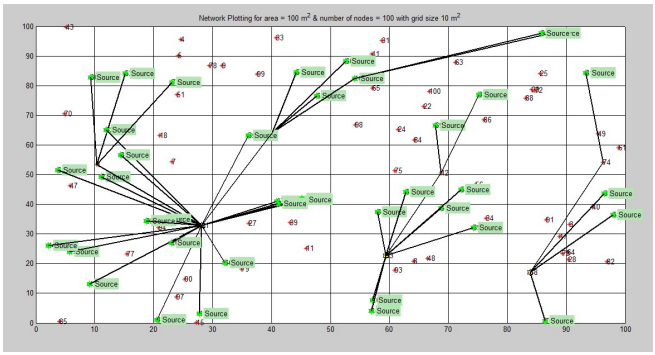

Figure.7. Simulation Output view-2

VI. CONCLUSION

In proposed work includes two objectives. At first a mobile base station approach is used to reduce the energy consumption of cluster heads in MANET'S by enclosing the base station to them while a fuzzy logic is applied to manage the base station move.

At second, AODV protocol has been implemented in order to prevent packet loss and fast delivery of data. The AODV protocol uses the mechanism of routing table and establishes minimum distance between cluster and the base station. According to the simulation results, the proposed scheme has proved its efficiency in the network lifetime, residual energy of network and load distribution. The proposed scheme also proved to have considerable efficiency in different scenarios.

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