ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 5, May 2015

An Efficient Traffic Analysis Based on Enhanced Loose Virtual Clustering For Power Heterogeneous MANETs

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ABSTRACT: In this paper, we propose a Loose Virtual Clustering algorithm to eliminate unidirectional links, benefit from high power nodes and to increase the throughput. Loose Virtual Clustering is enhanced to reduce the traffic that occurs in the clustering during the sensing process, increases the throughput and overall performance of the network. The method can effectively realize hierarchical power heterogeneous Ad hoc network. The objective of this work to assess the applicability of protocols in different traffic scenarios. Here topology based routing protocols, both proactive (DSDV) and reactive protocols (AODV, AOMDV, and DSR) have been considered for study. Performance metrics such as packet delivery ratio, throughput, end-to-end delay, bandwidth, control overhead and energy consumption are evaluated using NS-2.

KEYWORDS: AODV, AOMDV, DSR, DSDV, LVC, Power Heterogeneous.

I. INTRODUCTION

MANET is a self-configuring infrastructure less network of mobile devices connected by wireless links. Each device in a MANET is free to move independently in any direction, and also change its links to other devices frequently. The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic. Mobile Ad hoc networks may operate by themselves. MANETs are a kind of wireless ad hoc networks that usually has a routable networking environment on top of a Link Layer Ad hoc network. The growth of laptops and 802.11/Wi-Fi wireless networking has made MANETs a popular research topic since the mid 1990s. Many academic papers evaluate protocols and their abilities, assuming varying degrees of mobility within a bounded space.

Different protocols are evaluated based on measure such as packet drop rate, overhead introduced by routing protocol, end-to-end packet delays and network throughput. For Ad hoc wireless network, route discovery and route maintenance are two main tasks of the routing protocol. If the routing protocol is reactive (on-demand), then broadcasting route request is used to find a network route. To control propagation of broadcasting messages in the network, flooding control mechanisms are used to control the route request packet forwarding. An Ad hoc network is a wireless network formed by wireless nodes without any help of infrastructure. In this network, nodes are mobile and can communicate dynamically in an arbitrary manner. MANET is characterized by absence of central administration devices such as base stations. Nodes should be able to enter and leave the network easily. In these networks, the nodes act as routers. In these MANET, nodes act as routers. Routers play an important role in route discovery and maintenance of routes from source to destination. If link breakages occur, network has to stay operational by building new routes. The main technique used is multi-hopping is to increase the overall network capacity and performance. By using multi-hopping, one node can deliver data to a determined destination. Devices in MANET has limited power resources, addition of

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ISSN (Online): 2278 – 8875

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power to this lower power system degrades the simulation efficiency. In order to increase the power and simulation efficiency, power heterogeneous is used. Power heterogeneous has the ability to make the low power nodes to receive the transmission from higher power nodes. But the throughput of the power heterogeneous MANETs is severely affected by the high power nodes. In the high power nodes due to the variations in the transmission power, interference occurs. This interference occurring in the different nodes causes asymmetric links. Asymmetric links occurs between a pair of nodes and link quality will be different in each direction. An extreme case of asymmetric link leads to unidirectional links.

In this paper, Loose Virtual Clustering algorithm is designed to eliminate unidirectional links, benefit from high power nodes and to increase the throughput. Loose Virtual Clustering is enhanced to reduce the traffic that occurs in the clustering during the sensing process, increases the throughput and overall performance of the network. The method can effectively realize hierarchical power heterogeneous Ad hoc network. The objective of this work to assess the applicability of protocols in different traffic scenarios. Here we consider topology based routing protocols, both proactive (DSDV) and reactive protocols (AODV, AOMDV, and DSR) have been considered for study. Performance metrics such as packet delivery ratio, throughput, end-to-end delay, bandwidth, control overhead and energy consumption are evaluated using NS-2. Simulation results shows LVC routing protocol gives better performance than the other protocols.

II.ROUTING PROTOCOL

Routing is a process of sending a message from one mobile host in the network to another (it is also called *unicast*) [1]. Routing protocols for ad hoc wireless networks normally call for *mobility management* and *scalable design*. Mobility management is done through information exchanges between moving hosts in the ad hoc wireless network. In general, when information exchanges occur frequently, the network maintains accurate information of host locations and other relevant information. However, frequent information exchanges can be costly, because they consume communication resources including bandwidth and power. With less frequent information exchanges, these costs diminish but there is more uncertainty about the host's location. Scalable design (one that works for large size networks) requires both routing protocols and resource consumptions to be scalable [2-3].

Routing in the ad hoc wireless network poses special challenges because of its infrastructure less network and its dynamic topology. The tunnel-based triangle routing of mobile IP works well if there is a fixed infrastructure to support the concept of the "home agent". However, when all hosts move (including the home agent), such a strategy cannot be directly applied. Traditional routing protocols for wired networks, that generally use either *link state* or *distance vector*, are no longer suitable for ad hoc wireless networks [4]. In an environment with mobile hosts as routers, convergence to new, stable routes after dynamic changes in network topology may be slow and this process could be expensive due to low bandwidth. Routing information has to be localized to adapt quickly to changes such as hosts movement.

A routing protocol is needed whenever a packet needs to be handed over via several nodes to arrive at its destination. A routing protocol has to find a route for packet delivery and make the packet delivered to the correct destination. Routing Protocols have been an active area of research for many years; many protocols have been suggested keeping applications and type of network in view [5]. Routing Protocols in Ad Hoc Networks can be classified into two types:

A. Table Driven or Proactive Protocols

The nodes maintain a table of routes to every destination in the network, for this reason they periodically exchange messages. At all times the routes to all destinations are ready to use and as a consequence initial delays before sending data are small. Keeping routes to all destinations up-to-date, even if they are not used, is a disadvantage with regard to the usage of bandwidth and of network resources. Some of the famous table driven or proactive protocols are: DSDV, GSR, WRP, ZRP, STAR etc.

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B. DSDV

Destination Sequenced Distance Vector routing is a table driven routing scheme for ad hoc mobile network. The main contribution of the algorithm was to solve the routing loop problem. Each entry in the routing table contains a sequence number, the sequence numbers are generally even if a link is present, else an odd number is used. The number is generated by the destination and the emitter needs to send out the next update with this number. Routing information is distributed between nodes by sending full dumps infrequently and smaller incremental updates frequently.

C. On Demand or Reactive Protocols

These protocols were designed to overcome the wasted effort in maintaining unused routes. Routing information is acquired only when there is a need for it. The needed routes are calculated on demand [6]. This saves the overhead of maintaining unused routes at each node, but on the other hand the latency for sending data packets will considerably increase. Some famous on demand routing protocols are: AODV, AOMDV, DSR etc.

D. AODV

The Ad Hoc On-Demand Distance Vector routing protocol is a reactive routing protocol, the network is silent until a connection is needed. At that point the network node needs a connection broadcasts and request for connection [7-8]. Other AODV nodes forward this message, and record the node that they heard it from and creating an explosion of temporary routes back to the needy node. When a node receives such a message and already has a route to the desired node, it sends a message backwards through a temporary route to the requesting node. The needy node then begins using the route that has the least number of hops through other nodes. Unused entries in the routing tables are recycled after a time.

When a link fails, a routing error is passed back to a transmitting node, and the process repeats. Much of the complexity of the protocol is to lower the number of messages to conserve the capacity of the network [9]. For example, each request for a route has a sequence number. Nodes use this sequence number so that they do not repeat route requests that they have already passed on. Another such feature is that the route requests have a Time To Live number that limits how many times they can be retransmitted. Another such feature is that if a route request fails, another route request may not be sent until twice as much time has passed as the timeout of the previous route request. The advantage of AODV is that it creates no extra traffic for communication along existing links [10].

E. AOMDV

AOMDV is one of the most popular on-demand multipath protocols. It is an extension of a single-path routing scheme known as Ad Hoc On Demand Distance Vector (AODV), and it allows to compute multiple loop-free and link-disjoint paths between any source and destination nodes [11-12]. AOMDV extends the AODV protocol by computing multiple paths during route discoveries. To keep track of multiple routes, the routing entries in intermediate nodes contain a list of the next-hop nodes towards the destination node, and the corresponding hop counts. Additional information is required to ensure loop freedom and to compute node-disjoint and link-disjoint paths.

In AOMDV, different instances of RREQs are not discarded by intermediate nodes because they may provide information about potential alternate reverse paths: if a new RREQ instance preserves the loop free condition and comes from a different last-hop node, then a new reverse route towards the source node is logged in the intermediate node [13]. If the intermediate node knows one or more valid forward paths to the destination, a RREP packet is produced and forwarded back to the source along the reverse path. If possible, the intermediate node includes in the new RREP a forward path that was not used in any previous RREP, for this RREQ. The intermediate node re-broadcasts the new RREQs to neighbor nodes. When the destination receives more RREQ instances, in order to get multiple link-disjoint routes, it replies with multiple RREP messages. Node-disjointedness may be computed from link-disjoint paths simply preventing intermediate nodes from having more than one path passing through them.

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F. DSR

The Dynamic Source Routing protocol is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes.DSR allows the network to be completely self-organizing and self-configuring, without the need for any existing network infrastructure or administration. Dynamic Source Routing is a reactive routing protocol that uses source routing to send packets. It uses source routing means that the source must know the complete hop sequence to the destination.

Each node maintains a route cache; all routes it knows are stored. The route discovery process is initiated only if the desired route cannot be found in the route cache. To limit the number of route requests propagated, a node processes the route request message only if it has not already received the message and its address is not present in the route record of the message. DSR uses source routing, the source determines the complete sequence of hops that each packet should traverse. This requires that the sequence of hops is included in each packet's header. A negative consequence of this is the routing overhead every packet has to carry. One big advantage is that intermediate nodes can learn routes from the source routes in the packets they receive. Since finding a route is generally a costly operation in terms of time, bandwidth and energy, this is a strong argument for using source routing. The protocol is composed of the two main mechanisms of Route Discovery and Route Maintenance, works together to allow nodes to discover and maintain routes to arbitrary destinations in the ad hoc network.

III.EXISTING SYSTEM

The unique properties of mobile ad hoc networks such limited power, stringent bandwidth and large scale deployments have posed many challenges in the design and management of mobile ad hoc networks. In the existing scheme, the AODV and LRPH routing protocols are used.

Power heterogeneity is common in Mobile Ad hoc Networks. With high power nodes, MANETs can improve network scalability, connectivity and broadcasting robustness. The throughput of power heterogeneous MANETs could be severely impacted by high power nodes. A Loose Virtual Clustering based routing protocol for power heterogeneous MANETs is proposed. In particular, to explore the advantages of high power nodes and to control the traffic and to increase the performance of the network, a Loose Virtual Clustering algorithm is developed to construct a hierarchical network and eliminate unidirectional links. To reduce the interference raised by high power nodes, routing algorithms is developed to avoid packet forwarding through high-power nodes.

IV. PROPOSED SYSTEM

In this paper, we propose a Loose Virtual Clustering algorithm to eliminate unidirectional links, benefit from high power nodes and to increase the throughput. Loose Virtual Clustering is enhanced to reduce the traffic that occurs in the clustering during the sensing process, increases the throughput and overall performance of the network. The method can effectively realize hierarchical power heterogeneous Ad hoc network. The objective of this work to assess the applicability of protocols in different traffic scenarios. Here topology based routing protocols are considered, both proactive DSDV and reactive protocols AODV, AOMDV, DSR have been considered for study. Performance metrics such as packet delivery ratio, throughput, end-to-end delay, bandwidth, control overhead and energy consumption are calculated.

C. LRPH

A Loose Virtual Clustering based routing protocol for power heterogeneous MANETs, is compatible with the IEEE 802.11 DCF protocol. It does not rely on geographic information, or multi-radios multi-channel, and can be deployed on general mobile devices, including laptop and others. LRPH takes the double-edged nature of high-power nodes into account. To exploit the benefit of high-power nodes, a novel hierarchical structure is maintained in LVC, where the unidirectional links are detected effectively. Clustering is a known scheme to improve the performance

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of the networks. However, in the existing clustering schemes, each node in the network should play a certain role. This is defined as a strong-coupling cluster.

In a strong-coupling cluster, the cost of constructing and maintaining a cluster may increase significantly and affect the network performance. In Loose Virtual Clustering, a loose-coupling relationship is established between nodes. Based on the LVC, LRPH is adaptive to the density of high-power nodes. High power nodes with larger transmission range will create large interference areas and low channel spatial utilization. In such a case, routing algorithms is developed to avoid packet forwarding through high power nodes. Extensive analysis, simulations, and real-world experiments are conducted to validate the effectiveness of LRPH.

To improve the network performance and to address the issues of high-power nodes, LRPH MANETs is used. LRPH consists of two core components. The first component A is the LVC algorithm that is used to tackle the unidirectional link and to construct the hierarchical structure. The second component B is the routing, including the route discovery and route maintenance as shown in figure.1

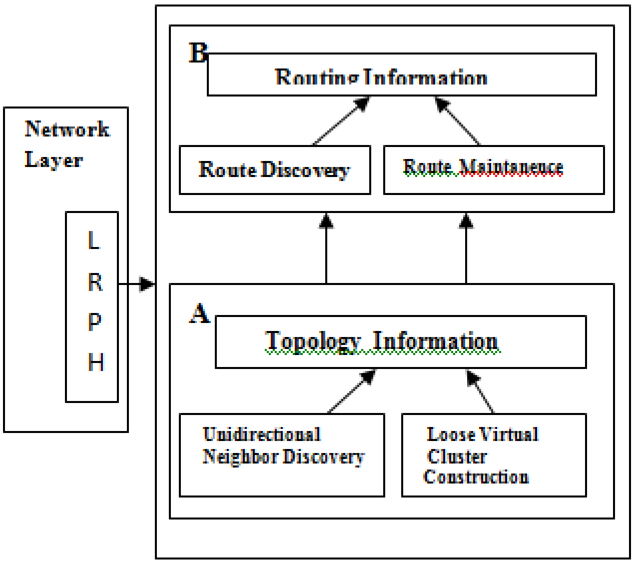

Fig: 1 Overview of LRPH

Procedures for discovering Bidirectional Nodes:
LVC Algorithm: The LVC algorithm. In LVC, unidirectional links in the network can be discovered using a BN discovery scheme. To exploit the benefits of high-power nodes, LVC establishes a hierarchical structure for the network.
Step 1: Each node broadcasts Bidirectional Neighbor Discovery packets within one hop and notifies all neighbors about its type or state.
Step 2: After sending BND packets, each node waits for T_{BND} to collect BND packets sent from its neighbors. The received BND packets will be used to construct the Aware Neighbor table, which stores the information of all discovered nodes.
Step 3: After waiting for T_{BND}, each node broadcasts BND packets again. In this step, the information on the node itself and all nodes in the A table will be added to the BND packets.
Step 4: When receiving BND packets, each node will check whether its own node information is in the BND packets. If so, a bidirectional link between the current node and the sender of that BND packet will be determined. the sender of the BND packet will be added into the BN table.

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D. ROUTING COMPONENTS IN LRPH

The routing components in LRPH, including the route discovery and route maintenance. In the route discovery, the route to the destination can be obtained effectively based on LVC. In the route maintenance procedure, route failure cases are dealed.

Route Discovery Procedure: When source node S wants to send a data packet to destination node D, S first searches whether the route to D exists in its route cache. If the route exists, S directly sends the data packet. Otherwise, S activates the route discovery procedure to find a route to D. The route discovery process consists of the local routing and global routing components.LR, if *D* is in the LAT table, the route to *D* will be directly obtained. If *D* is not in the LAT table, *S* broadcasts a route request packet to discover the source route to *D*. When a node receives the complete route to *D*, it replies with a route reply packet to *S*. After *S* receives the RREP packet, it inserts the new route into its route cache and sends data packets.

LVC Maintenance: When links between nodes fail, the maintenance of LVC will be activated. In particular, when node n_i detects any of the following conditions based on the periodical BND packets, it enters the procedure of LVC maintenance. If node n_i does not receive the BND packet from node n_j in the AN table within a time window, n_j should be out of its coverage range. If node n_i receives the BND packet from node nj and node n_j is not in the AN table, a new link between n_i and n_j should be added.

V. SIMULATION AND PERFORMANCE

Simulation results have been performed for of Packet Delivery Ratio, Throughput, End-to-End Delay, Bandwidth, Control Overhead and Energy Consumption evaluations.

A. Simulation Parameters

Simulation Time	100s
Topology Size	1000m x 1500m
Number Of Nodes	100
MAC Type	MAC 802.11
Pause Time	0s
Max Speed	4m/sec-24m/sec
Initial Energy	100J
Transmit Power	0.4W
Receive Power	0.3W
Traffic Type	CBR

B. Simulation window

The goal of Cluster formation is to impose some kind of structure or hierarchy in the otherwise completely disorganized ad hoc network.

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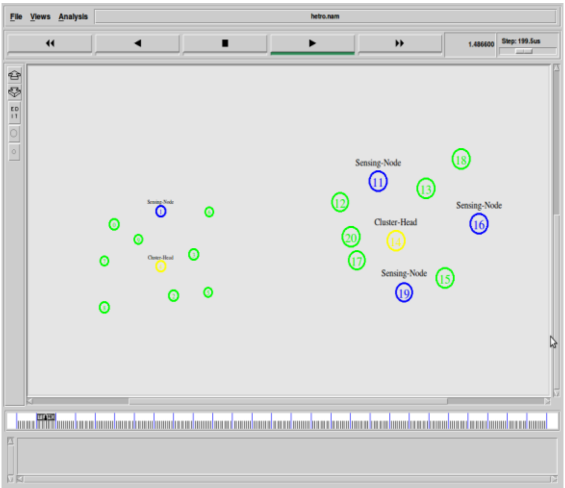

Fig: 2 Cluster head selection

Fig: 2 shows that, algorithm is a variation of the simple lowest ID clustering algorithm in which the node with a lowest ID among its neighbors is elected as the Cluster head. Based on the power levels present in each node ,sensing node and cluster head are selected. Node having higher power level is selected as sensing node and the node having lower power level is selected as cluster node.

C. Packet Delivery Ratio

Packet Delivery Ratio (PDR) is the ratio between the number of packets transmitted by the a traffic source and number of packets received by a traffic sink. It represents the maximum throughput that the network can achieve.

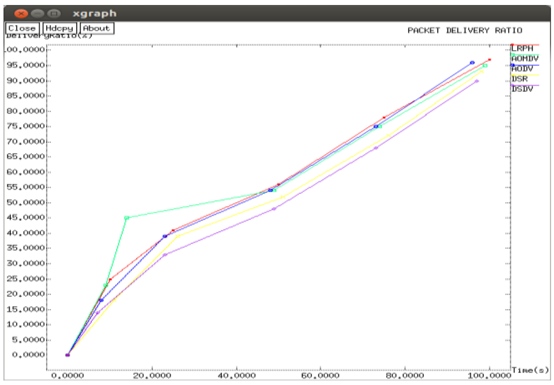

Fig: 3 Packet Delivery Ratios versus Time

Fig: 3 show the Packet Delivery Ratio on varying the time. The graph shows that LPRH has efficient Packet Delivery Ratio when compared to AODV, AOMDV, DSR, and DSDV.

D. Throughput

The term throughput is the ratio of the total amount of data that a receiver receives from a sender to a time it takes for receiver to get the last packet. A low delay in the network translates into higher throughput.

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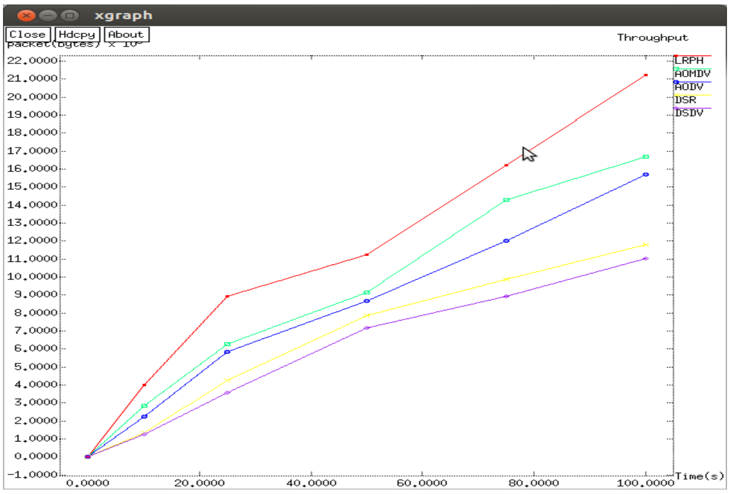

Fig: 4 Throughputs versus Time

Fig: 4 show Throughput on varying the time. The graph shows that LPRH has efficient Throughput when compared to AODV, AOMDV, DSR, and DSDV.

E. Control Overhead

Routing control overhead is the ratio of number of routing control packets to delivered data packets. Overhead for both protocols increases with increasing node mobility because the more quickly changing network topology increases routing update frequency.

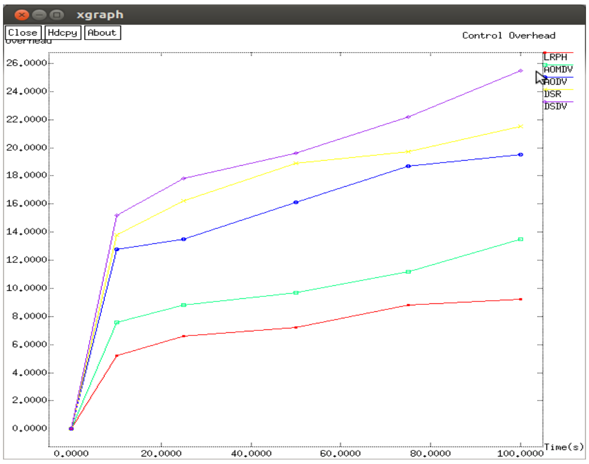

Fig: 5 Overhead versus Time

Fig: 5 show the Routing Control Overhead on varying the time. The graph shows that LPRH has Routing Control Overhead less compared to AODV, AOMDV, DSR, and DSDV.

F. End To End Latency

The term the average delay is a data packet experiences to cross from source to destination. This delay includes all possible delays caused by buffering during route discovery delay, queuing at the interface queues and retransmission delays at the MAC, propagation and transfer times.

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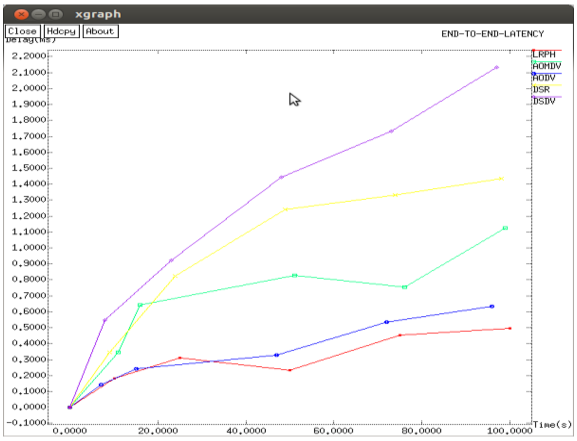

Fig: 6 Delay versus Time

Fig: 6 presents low latency of LPRH compared to the AODV, AOMDV, DSR, and DSDV. This low latency of LPRH will provide good performance.

G. Bandwidth

Bandwidth in computer networking refers to the data rate supported by a network connection or interface. One most commonly expresses bandwidth in terms of bits per second (bps)

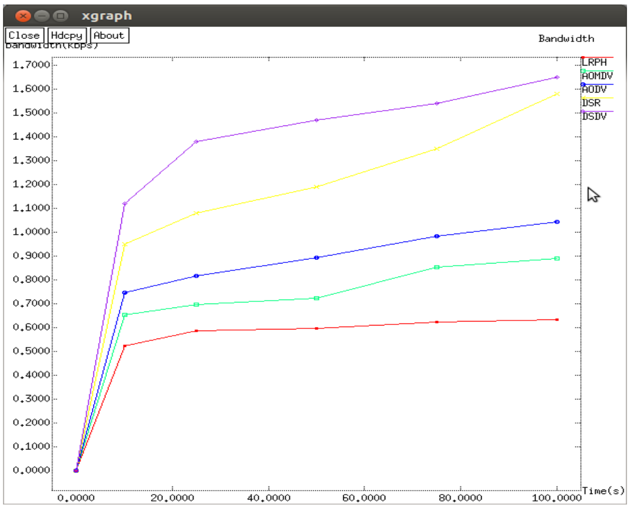

Fig: 7 Bandwidth versus Time

Fig: 7 shows the Bandwidth on varying the time. The graph shows that LPRH has better Bandwidth compared to AODV, AOMDV, DSR, DSDV.

H. Energy Consumption

Energy Consumption is the total amount of energy saved when sending the packets from the source to destination.

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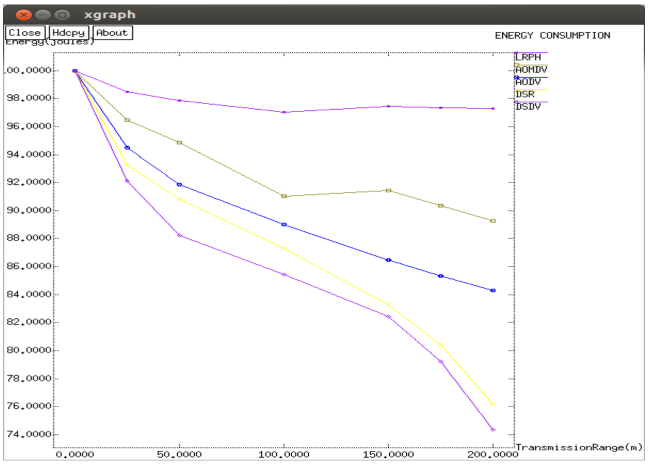

Fig: 8 Energy versus Transmission Range

Fig: 8 shows the Energy Consumption on varying the time. The graph shows that LPRH provides good energy consumption compared to AODV, AOMDV, DSR, DSDV.

I. Comparision Table

TABLE 1 Performance Analysis

Protocols	**PDR (%)**	**Throughput (kbytes)**	**Control Overhead (bytes)**	**End-to-end Delay (ms)**	**Bandwidth (kbps)**	**Energy (Joules)**
AODV	96	15.9	19.8	0.65	0.14	84.3
AOMDV	95	16.9	13.8	1.13	0.89	89.2
DSR	94	11.9	21.8	1.42	1.59	76
DSDV	90	11	25.6	2.15	1.67	74.2
LRPH	97	21.3	9.3	0.5	0.64	96.6

VI. CONCULSION AND FUTHER WORK

Loose Virtual Clustering based routing protocol named LRPH for power heterogeneous MANETs is developed. LRPH is considered to be double edged sword because of its high power nodes. LVC algorithm is designed to eliminate unidirectional links, benefit from high power nodes and increases the throughput. The performance Loose Virtual Clustering is compared with the four protocols (both reactive and proactive) like AODV, AOMDV, DSR, DSDV. Here, the performance on the basis of Packet Delivery Ratio, Throughput, End-to-End Delay, Bandwidth, Control Overhead and Energy Consumption are found . By comparing these protocols on the basis of various performance metrics, it has been reached to a conclusion that LRPH is better than the other routing protocols.

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In the LVC, during the cluster head selection in the sensing node there occurs traffic and reduces the performance. Cluster heads are selected based on the minimum values it has. During sensing process in the cluster if new node arrives ,cluster head is changed based on the minimum values of the incoming node .When a single new node comes to the cluster, it is easy to calculate the cluster head. If more number of new nodes arrive , LRPH calculates the new cluster head but the process of calculating is slow and there occurs traffic and the performance is reduced. So LVC algorithm is enhanced to reduce the traffic during the selection of cluster heads.

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