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Energy Efficient Expanding Ring Search Algorithm for AODV

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Abstract - In wireless technologies, such as, mobile ad-hoc network (MANET) is increasing and it influences the development of new theories and structures for the communication. The aim of this protocol is minimizing the energy dissipation of the Mobile Ad-hoc network. This protocol is based on Ad-hoc On Demand Distance Vector Routing (AODV). These routing protocols are used to deal with dynamic communication. In On-demand multi-hop routing protocols e.g., AODV and DSR, the route discovery process uses Expanding Ring Search heuristic algorithm for reducing broadcast overhead and saving energy consumption. Energy efficiency is achieved by eliminating most of the redundant broadcasts. The goal of this algorithm is to find the nodes having information needed about the destination in their route caches. The source node is the centre of the search ring. ERS successively searches the large area until the node having needed information being searched is found. In this algorithm Time to Live (TTL) mechanism is used in route discovery process. The energy consumption depends on TTL value. Increment or decrement of TTL value is done until the destination is found.

Key Words: wireless technologies, Mobile Ad-hoc network, AODV, Expanding Ring Search, Time to Live (TTL).

1. INTRODUCTION

A mobile ad hoc network (MANET) is a self-configuring, infrastructure-free network of linked mobile devices that is continuously self-configuring. Every device in a MANET is free to travel in any direction and therefore changes its connections to other devices on a regular basis.

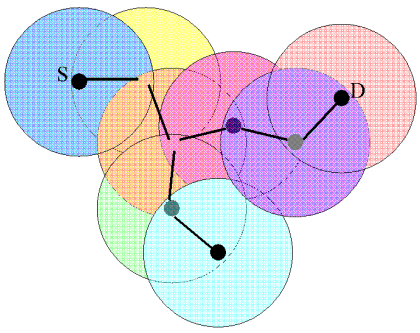


Figure 1: Mobile Ad-hoc Network

Mobile nodes re-configure themselves as they move around, resulting in a temporary network that appears spontaneously. The absence of central support and the unique dynamic properties leave it open to problems. Routing is one of the most significant problems in telecommunications. Every node interacts with every other node in its transmission range. If another node is out of range, an intermediary node relays its messages. Communication is troublesome due to the nodes moving around often. In order to overcome this problem, a routing protocol is needed.

MANET may function alone as an online application or with a broader internet environment. One or more transceivers are placed at nodes, making it a highly dynamic autonomous architecture. One of the greatest problems is to equip each device with the means to retain information needed to send data successfully. MANETs use a peer-to-peer network, and the nodes of the network have the ability to autonomously create, as well as repair themselves. the radios we've been using for almost two decades transmit at radio frequencies (30MHz-5GHz). This may be utilised in many ways, including sensors for road safety, including in environments, homes, health, rescue operations, defence, weaponry, robotics, and more.

Dynamic Topologies:

Network topology that often consists of several hops may change often and unexpectedly over time, sometimes resulting in a one-way or two-way connection.

Bandwidth constrained, variable capacity links:

Although they are far more common, wireless networks are worse in quality and don't often match wired networks.

Autonomous Behavior:

Every node may serve as a host and router, showing it is capable of independent operation.

Energy Constrained Operation:

The fact that nodes may need batteries to get their energy, and these batteries may run out. Mobile nodes, in general, are less capable since they have memory, power, and lightweight limits.

Limited Security:

There are several security risks when it comes to wireless networks. Due to its distributed functioning, there's no centralized firewall. This is to help with security, routing, and host setup.

Less Human Intervention:

They are self-configuring because of their independent nature and little human involvement in their setup.

Pros and Cons of MANET –

Pros:

being independent of centralized network management

Autonomous, the nodes are capable of playing both roles (router and host) since they are capable of serving multiple purposes.

Computers running the blockchain are able to self-configure and self-heal without human intervention.

Cons:

Resources are few, and with increasing noise and interference, it's hard to proceed.

Inaccessibility to identification papers.

More prone to being attacked, due to the lack of armour.

Types of MANET –

Vehicular Ad hoc Network (VANETs) –

Let vehicles talk to one other and devices like traffic lights. Intelligent Vehicular Ad Hoc Networks (InVANETs) is another name for vehicles working together with the other vehicles and roadside equipment.

Smart Phone Ad hoc Network (SPANC) –

Without the need for cellular carrier networks, or conventional network infrastructure, creating a peer-to-peer network. Peer may be added or removed from the network without jeopardizing its integrity.

Internet based Mobile Ad hoc Network (iMANETs) –

It supports TCP/UDP and IP, two Internet protocols. To connect mobile nodes together and create routes with dispersed, automated settings.

Hub-Spoke MANET:

A geographically distributed MANET may be created by using a hub-spoke VPN that links several sub MANETs. The typical method of routing cannot be used.

Military or Tactical MANETs –

The military uses this for its units. Strong emphasis on things like real-time requirements, rapid mobility re-routing, security, and other factors, such as radio range.

Flying Ad hoc Network (FANETs) –

the following is comprised of drones: (commonly known as drone). Brings people together in distant places, and promotes mobility.

There are three kinds of routing protocols. The three routing protocols mentioned above are defined as Proactive, Reactive, and Hybrid.

Mobility models for MANETs

On our experience with ERS Mobility models are necessary since they are responsible for setting mobile node (MN) behaviour (Camp, Boleng, & Davies, 2002; Niewiadomska-Szynkiewicz, Sikora, & KoAodziej, 2013). There are two kinds: Those based on footprints (actual movements) and the fabricated (emulate reality by mathematical equations). Other studies divide mobility models into three groups: those that focus on strokes (the actual thing), topological constraints (real simulation) and statistics ("stat" with " ive" as an acronym: Statistics may help bring dynamic data analysis closer to the kind of flexibility that managers want) (study from randomness).

Emergency and rescue scenario for center of the city of Loja

For the convenience of readability, the ERS was modelled with an area of 1000m x 500m in the city of Loja for the purposes of the graph in Figure 2. Valle, San Sebastian, Sagrario, and Sucre parish people have taken part. The Random Waypoint Mobility Model, interferes with the node's habitual movements.

CHARACTERISTICS OF MANETs:

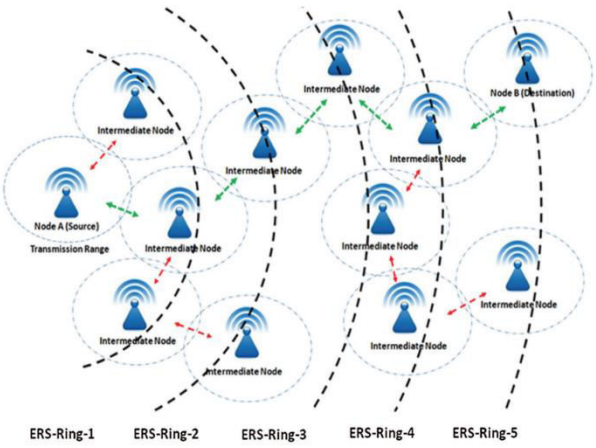
- Every node in MANET does double duty, being both host and router. It behaves on its own.
- When routing a message, the MANETs are able to use multi-hop radio relaying to route messages via intermediary nodes.
- It's a feature that makes some things, like keeping safe, easier to do since it is handled via independent processes. There is no firewall at the network's centre.
- The nodes may be freely added or subtracted from the network, meaning that the network's topology can change on a whim.
- Mobile nodes tend to have less weight, less power, and limited memory, because to their tiny size.
- When compared to wired connections, wireless communications are typically less reliable,

efficient, stable, and capable. This demonstrates the variance in wireless connection bandwidth.

- Network setup that needs as little human involvement as possible, whether via a phone or anything else.

2. PROJECT OVERVIEW

Advances in mobile ad-hoc networks have put great strain on man-made infrastructure and communication paradigms (MANET). The objective of this protocol is to reduce the amount of energy used by Mobile Ad-hoc networks. The protocol is based on the Ad-hoc routing, which helps computers find each other and establish communication (AODV). To handle a dynamic communications environment, you utilise routing protocols. The Expanding Ring Search heuristic method, used in protocols like AODV and DSR for routing discoveries, saves energy usage and decreases broadcast traffic. One way to improve energy efficiency is to cut out the unnecessary broadcasts. The algorithm has the task of locating the nodes with the necessary destination information in their route caches. The search ring starts at the source node. ERS looks for essential information by going through a wide region repeatedly. Route discovery uses a TTL technique in this approach. How much energy is used depends on the TTL. TTL values are changed until the destination is discovered.



3. PROJECT SCOPE

Ad-hoc networks often develop in environments where there are several battery-powered devices. The routing procedure requires more energy in the AODV protocol because of the increased overhead it brings about by storing redundant routing information. RREQ is decreased in the routing algorithm in the current design. Therefore, any node in the network may utilize the network's energy to its full potential. Our approach lowers both energy use and routing costs owing to node mobility. Ad-hoc networks often develop in environments where there are several battery-powered devices. The routing procedure requires more energy in the AODV protocol because of the increased overhead it brings about by storing redundant routing information. RREQ is decreased in the routing algorithm in the current design. Therefore, any node in the network may utilize the network's energy to its full potential. Our approach lowers both energy use and routing costs owing to node mobility.

4. EXISTING SYSTEM

Devices inside a wireless ad-hoc network may interact with each other without needing a centralized hub. A node in a MANET operates in both host and router capacities. Two groups define ad-hoc routing protocols: static and dynamic. They may be either on-demand or proactive (i.e., reactive). In protocols using a proactive approach, routing information is kept constant across all nodes. Route changes are constantly sent across the network, keeping the routing knowledge fresh. Reactive protocols have the source start things. It signifies that if a node requires a route to another node, it will go about finding that route. It follows that only routes are created when required. Most mobile devices in a standard ad hoc network are powered by batteries. Ad hoc networks are comprised of mobile nodes, and they function with a minimal amount of power. These nodes have the capacity to organised themselves in a multi-hop setting. Nodes in MANETs utilize routing protocols to route packets effectively, especially when cooperation between mobile nodes helps the packet get through intermediate nodes. In AODV protocol, a node wishing to send a packet first broadcasts a request message, which is sent to every node in the network. All nodes re-transmit this message to find a route to the target. Route discovery occurs, and in certain instances, having to relay all the nodes' messages creates a significant overhead in energy usage.

5. PROPOSED SYSTEM

Ad hoc networks are comprised of mobile nodes, and they function with a minimal amount of power. These nodes have the capacity to organise themselves in a multi-hop setting. The goal of this protocol is to keep Mobile Ad-hoc network energy dissipation low. This protocol is based on Ad-hoc On Demand Distance Vector Routing (named Ad-hoc) which is used for establishing communications among computers (AODV). To handle a dynamic communications environment, you utilize routing protocols. The Expanding Ring Search heuristic method, used in protocols like AODV and DSR for routing discoveries, saves energy usage and decreases broadcast traffic. One way to improve energy efficiency is to cut out the unnecessary broadcasts. The algorithm has the task of locating the nodes with the necessary destination information in their route caches. The search ring starts at the source node. ERS looks for essential information by going through a wide region repeatedly.

6. SYSTEM DESIGN

DATA FLOW DIAGRAM:

Data flow diagrams (DFDs) are a graphical depiction of information system process aspects that demonstrate the movement of data. DFDs describe the information system's process. To generate a summary of the system without delving into too much detail, a DFD is frequently used as a first step. For visualizing data processing, DFDs may be used (structured design).

A DFD illustrates the kind of information to be entered, output, transferred, and stored by the system. Processes are complex to define, so it is not possible to find process timing and sequential/parallel options, which is done in traditional structured flowcharts. Additionally, traditional flowcharts focus on control flow and UML activity workflow diagrams display control and data flow as a unified model.

In the context of data flow diagrams, the conventions include standards to help identify the four different components; this includes drawing all four components and representing them with symbols.

DATA FLOW DIAGRAM LEVEL-0:

Level 0 DFDs, Context diagrams are the most basic kind of data flow diagram, and they are also called context diagrams. They give a big-picture perspective that's simple to understand, but doesn't provide many details. The flow of data between a single process node and the rest of the world is shown via Level 0 data flow diagrams. It covers everything from the ground up. The relationships with external entities are shown well.

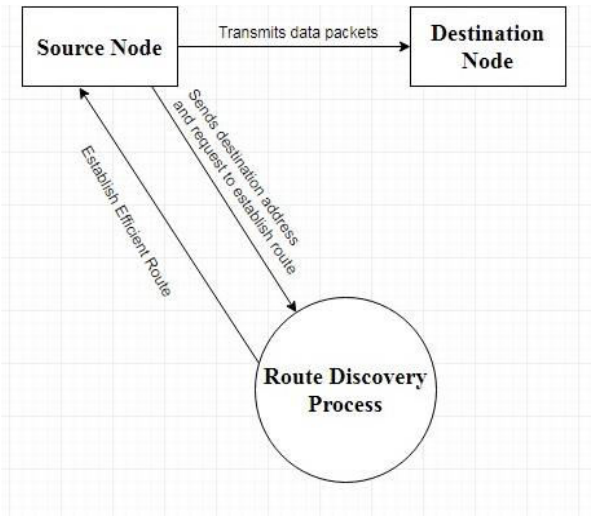


Figure 2: Data Flow Diagram Level-0

DATA FLOW DIAGRAM LEVEL-1:

Level 1 DFDs they are more detailed than a context diagram to create a level 1 data flow diagram, the context diagram's single process node is split down into several sub-processes. Additional data flows and data storage will be needed to connect these processes together since they're being added to the diagram.

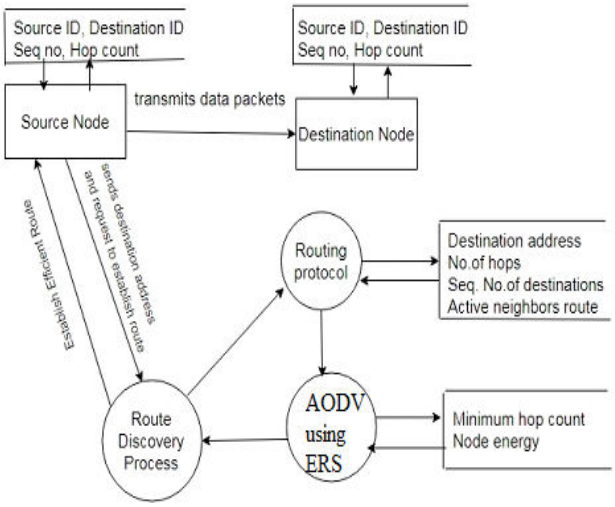


Fig.3. Data Flow Diagram Level-1

DATA FLOW DIAGRAM LEVEL-2:

Level 2 DFDs Breaking complex procedures into simpler sub-processes will simply work. DFDs are often said to have more capabilities, but in practice, they seldom do. It's generally not necessary to break level 3 data flow diagrams down any further since they are sufficiently comprehensive.

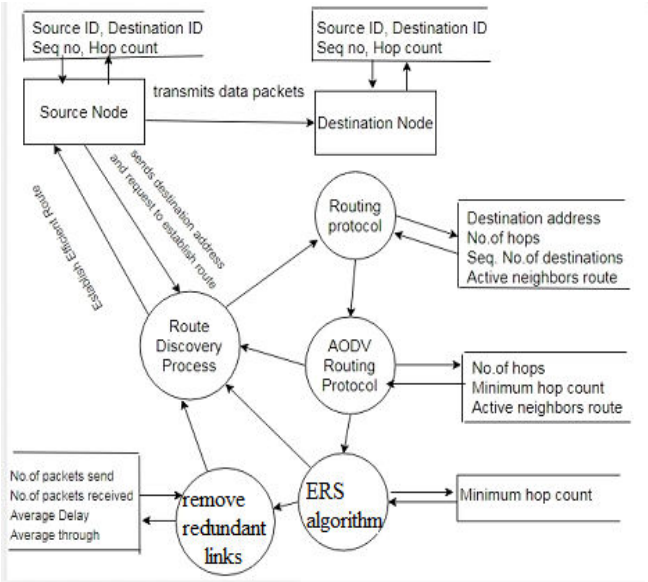


Fig.4. Data Flow Diagram Level-2

SYSTEM ARCHITECTURE:

A system architecture describes how the system is built and how it functions, among other things. To help understand the system, a formal, logical description of it should include its structures and behaviour. An organization's wide range of structures includes products like extendable frameworks to aid in the operation of large groupings of materials.

SYSTEM ARCHITECTURE:

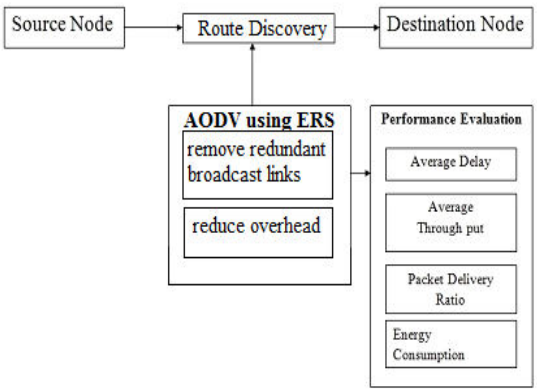


Fig.5. System Architecture

ALGORITHM SPECIFICATION:

AODV ALGORITHM:

- Source initializes for communication
- Searches for neighbor nodes
- Then sends RREQ to neighbors until destination node receives the RREQ
- Route which has minimum hop count is selected

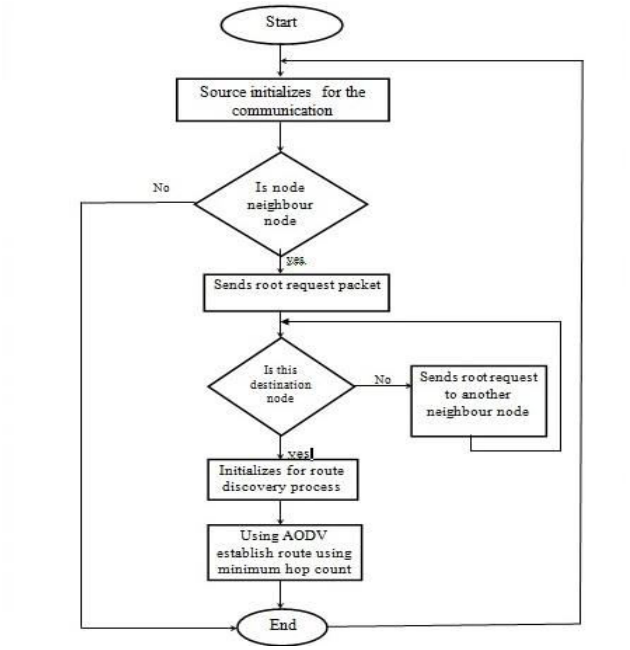


Fig..6 Flowchart for Ad-hoc On-Demand Distance Vector routing protocol

AODV using ERS:

For route discovery, the Expanding Ring Search algorithm is used in the AODV protocol that incorporates the suggested route discovery mechanism. It lowers overhead by cutting out unnecessary broadcasts. ERS has a TTL technique to help prevent duplicative data transfers. The algorithm's goal is to cut energy use by minimizing wasted resources. as described earlier, the method goes like this

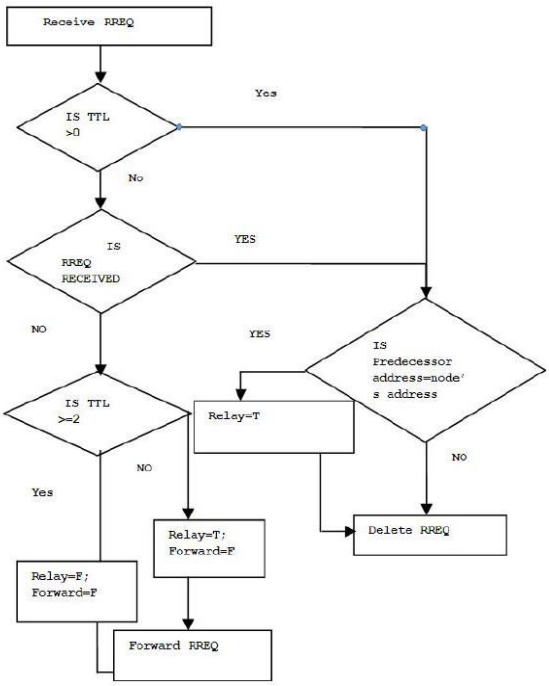


Fig.7 Flowchart for Ad-hoc On-Demand Distance Vector using Expanding Ring Search algorithm.

7. RESULTS

When project design is converted into functioning system, the process is said to be implementation. The first stage is the most important step in building a new system and getting the user to feel comfortable that the new system will function well.

During the implementation phase, the planning process includes researching the current system and examining its restrictions on implementation, preparing for how to complete change, and assessing the success of the implementation techniques. Turning innovative system designs into usable procedures is what's called implementation. It is the step that's all about user training, preparing of the site, and converting files to have a new system installed.

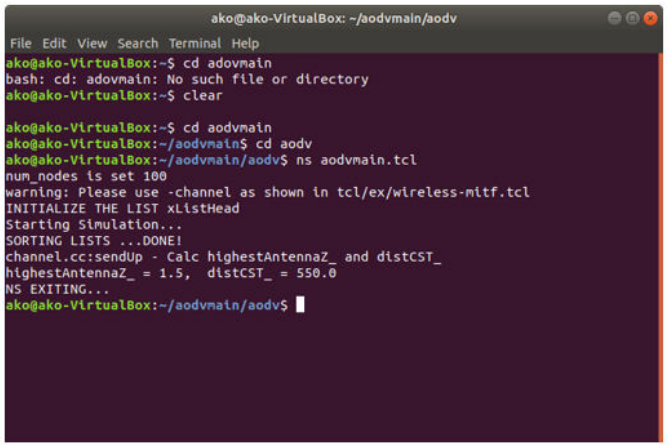


Fig.8. Executing Scripts

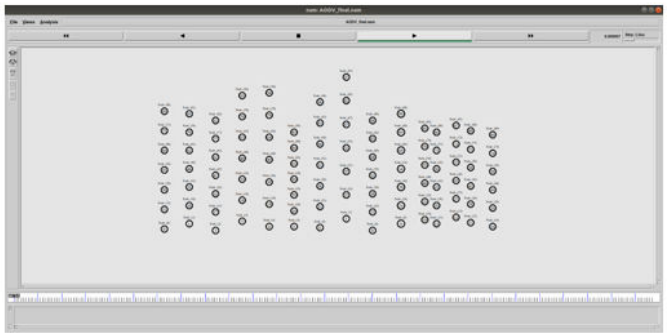


Fig.9. Sample network creation

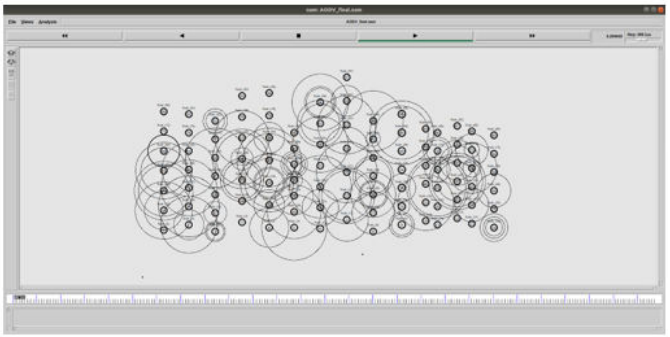


Fig.10. Simulation using AODV protocol in NAM

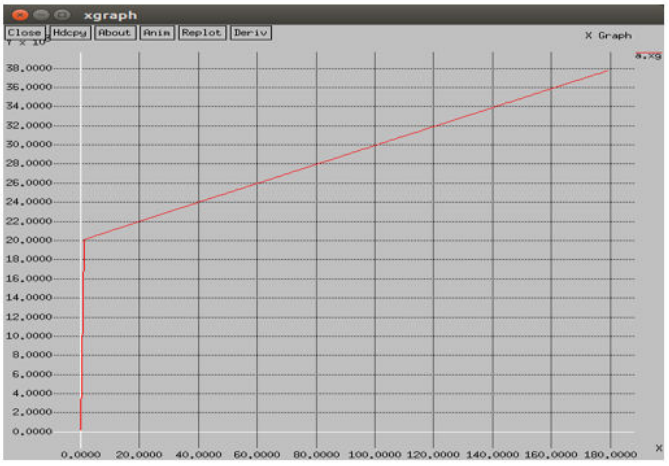


Fig.11. Energy utilization of AODV using X-Graph utility

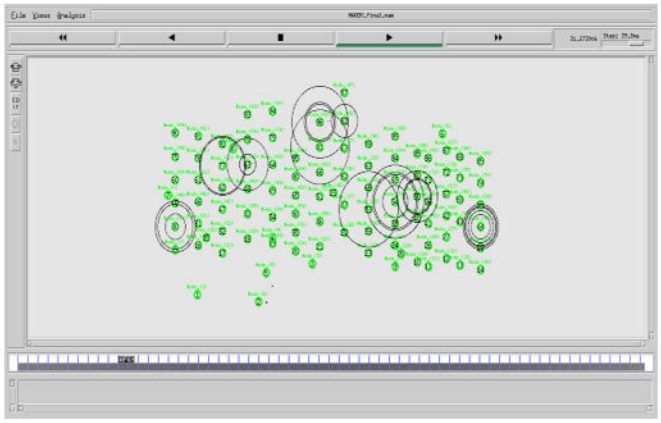


Fig.11. Simulation using AODV protocol by using ERS in NAM

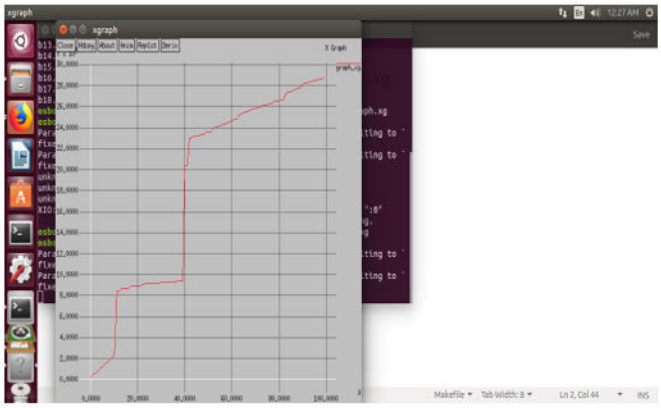


Fig.12. Energy utilization of AODV by using ERS using X-Graph utility

8. CONCLUSION

From the simulation performed for various scenarios, the following conclusions can be made.

Energy: AODV using ERS has Energy consumption less than AODV protocol.

Average Throughput: AODV using ERS has highest Throughput than AODV.

Thus, AODV using ERS has highest throughput giving better network lifetime than AODV and less average delay as compared to AODV.

Our project POs and PSOs has achieved the following level of attainments:

POs and PSOs Mapped: PO1, PO2, PO3, PO4, PO5, PO9, PO12, PSO1, PSO2

PO'S and POS's	PO1	PO2	PO3	PO4	PO5	PO9	PO12	PSO1	PSO2
Levels	H	M	M	L	L	M	L	L	L

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