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Review of Energy Conservation Approaches in MANET

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Abstract—Mobile adhoc network consists of collection of wireless mobile nodes dynamically forming a temporary network without the use of any pre existing network infrastructure or centralized administration.energy conservation is necessary due to increasing gap between the power consumption requirements and power availability.To maximiseadhoc networks lifetime traffic should be send through route that prevents the nodes with low energy. Main objective is to usevarious techniques such as energy efficient routing, power awareness and loaddistribution with respectiveof advantages and disadvantages.

Keywords— MANET, Routing, Network lifetime, Energy consumption,Power Awareness

I. INTRODUCTION

1.1 MANET

A mobile adhoc network [6,8] is a dynamic distributed system of wireless mobile nodes in which the nodes can move in any direction independent of each other. In MANET, there is no central infrastructure and the mobile devices are moving randomly and they may give rise to various kinds of problems such as energy efficiency and power consumption within a network. Figure 1.1, shows a general structure of MANET.

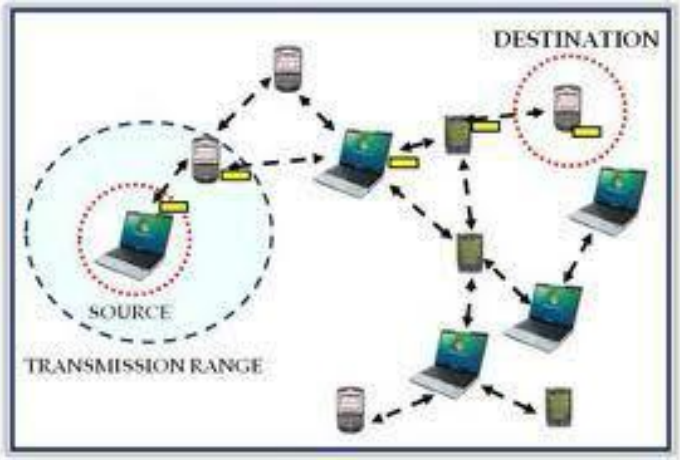

Fig. 1.1 - Mobile Ad hoc Network

1.2PROTOCOL STACK FOR MANET

Protocol stack for mobile infrastructure-less networks[12] is described. The protocol stackwhich consists of five layers (a) physical layer (b) data link layer (c) network layer (d) transport layer (e) application layer. The layers of OSI(a) session (b) presentation (c) application are merged into one section called application layer. It is a layered framework designed for the purpose of network systems that allows for communication acrossall types of computer systems. TCP/IP was designed first. The last four layers of OSI model are the same but the fifth layer in the TCP/IP suite (the application layer) is equivalent to the three layers (a) session (b) presentation (c)application layers of the OSI model. The difference between two protocol stacks lies in the network layer. .

1.3 ENERGY CONSERVATION IN MANET

The reasons forthe power management in ad hoc networks are below [3]:

Limited Energy Reserve: Power resources are limited in adhoc networks. The energy conservationisnecessary due to increasing gap between the power consumption requirements and power availability.

Difficulty to Replace Batteries: To replace or recharge batteries in some situations is very difficult. Power management is essential in such situations.

Optimal Transmission Power: Increase in transmission power will increase the battery charge. Select of optimum transmission power is important for effectively utilizing the battery power.

Battery constraint: Size of mobile nodes will be increased by batteries. If size of battery is reduced it will results in less capacity. Conservation of energy is needed in addition to battery size reduction.

Channel Utilization: Transmission power reduction will increase due to frequency reuse. To have the required SIR at receiver and to increase the channel reusabilitypower control is necessary.

1.4 POWER SAVING ISSUES IN MANET

The power-saving issues in MANET can be categorized as follows [14]:

Transmission Power Control: Transmission power control has strong impact on transmission rateand inter-radio interference in wireless communication.TransmissionPower control is used to reduce interference and improve throughput on the MAC layer. The network topology called Topology control helps to determining transmission power of each mobile host .

Power-Aware Routing: Power-aware routing protocols have been proposed based on various power cost functions. In [10] packetsare not forwarded for other hostswhen a mobile host'sbattery level is below a certain threshold. Both host lifetime and distance power metric are considered in reference[15].

Low Power Mode: More number of wireless devices can support low-power modes. IEEE 802.11 have radio which only needs to be awake periodically. HyperLAN allows a mobile host which are in power-saving mode to define its own active period. The host(active) may save powers by turning off its equalizer according to the transmission bitrates.Comparisons helps to study the power-saving mechanisms of IEEE 802.11 and HYPERLAN in ad hoc networks.

1.5 APPLICATIONS OF MANET

Military Scenarios: MANET provides network for military communications and automated battle fields.

Rescue Operation: The network provides recovery of disaster which means replacement of fixed infrastructure network

Data Networks: The network needed for the exchange of data between mobile devices is provided by MANET.

Device Networks: These supports the wireless connections between various mobile devices for communication purpose.

Free Internet Connection Sharing: It also helps us to share the internet with other mobile devices.

CHALLENGES OF MANET

Battery constraints: The devices used in these networks have restrictions on the power source in order to maintain portability, weight and sizeof the device.

Routing Problem: In wireless networks the nodes often change their location within network.Therefore, some stale routes are generated in the routing table which leads to unnecessary routing overhead.

Hidden Terminal Problem: This problem refers to the collision of packets at a receiving node due to the simultaneous transmission of those nodes that are not within the direct transmission range of the sender but within the transmission range of the receiver.

Packet loss due to error in transmission: Adhoc wireless networks experiences a much higher packet loss due to factors such as increasedcollisionsand unidirectional links.

Mobility-induced route changes: The network topology in an ad hoc wireless network is highly dynamic due to the movement of nodes; hence frequent path breaks happens and this leads to frequent route changes.

Limited bandwidth: Mobile networks have significantly lower capacity than infrastructure networks. The result of wireless communication after accounting for the effect of multiple access and interference conditions is much less than maximum rate of radio transmission.

Problems of security:MANETs wireless nature brings new security challenges to the network design.

II. LITERATURE SURVEY

Various approaches used for the energy efficiency and power consumption in wireless adhoc networks are given below:

A.Energy Efficient Routing

The protocol is implemented byAlphonsa Xavier1, R. N Gaur2 in 2014 [1]and authors proposed that although establishing correct and efficient routes is an important design issue in MANETs still more challenging issue is to provide energy efficient routes because mobile nodes' operation time is the most critical limiting factor. To increase the lifetime of ad hoc networks traffic should be sent via a route that can avoid nodes with low energy while minimizing the total transmission power. The energy node depletiondoes not affect the node itself only but the overall network lifetime.

B. Power Aware Routing Mobile Adhoc Network

The authors Dave YogeshkumarMukundray, Amit R.Sharma in 2014 implemented an algorithm [2] to maximize the network lifetime by avoiding the routing through nodes with less battery power. MANET consists of portable mobile nodes communicate directly with each other without any central infrastructure. In the absence of central infrastructure, a node establishes communication network and act as router as well. Nodes are battery operated and mobile hence network topology changes frequently. In MANET, resources are limited. Nodes battery power is one of the important resources.

Ad hoc On demand Distance Vector AODV is a reactive protocol which establishes the network connection when needed. AODV establish the route when nodes have data for communication. Route breaks when nodes run out of battery power. Routing will be done through the nodes with sufficient battery power. Power aware routing mobile adhoc network algorithm is developed and simulated using NS-2.

C. Energy Efficient Routing Techniques

Akanksha Meshram1, M .A. Rizvi2 proposed an approach [3] that reduces energy consumption and prolonging battery life power conservation techniques at various layers and energy efficient routing technique. Energy management is the most important performance metrics for mobile ad hoc networks because it directly relates to the operational lifetime of the network. Many research efforts focused on performance comparisons and trade studies between various low-energy routing and self-organization protocols. Therefore we get little information about the relationship between the aggregate energy consumption. Despite the fact that devices are getting smaller and more efficient, advancements in battery technology have not yet reached the stage where a mobile computer can operate for days without recharging.

D. Load Distribution and Power Awareness

Shiva Prakash, J.P.Saini in 2013 [4] proposes an approach for minimization of energy consumption of individual nodes. Wireless network consists of collection of wireless mobile nodes dynamically forming a temporary network without the use of any pre existing network infrastructure or centralized administration. Network partition occurs if power of battery is fully depleted. As a resultthese nodes becomes a critical spot in the network. The critical nodes can deplete their battery power earlier because of excessive load and processing for data forwarding. Therefore loads that are unbalanced turns to increase the chances of nodes failure and network partition and hence reduce the route lifetime and reliability of the MANET. Therefore in infrastructure-less networks(wireless) the energy consumption issue becomes the vital research topic. The paper provides numerous energy-efficient routing mechanisms proposed for wireless networks. We get detailed comparative study of lager number of energy efficient/power aware routing protocol in MANET. The main target is to helps the new researchers and application developers to explore an innovative idea for designing more efficient routing protocols.

E. Use of Radio Activated Switch (RAS)

S.Rajeswari1 , Y.Venkataramani2 in 2012 implements a new method for energy efficiency [5]. Protocol are required for better network performance based on energy resource due to limited battery power in Mobile Ad hoc network (MANET) nodes. A modified Protocol for MANET to achieve energy efficiency and reliability is implemented. The probability value can be adjusted by Radio Activated Switch (RAS) which is embedded in each node. Energy is preserved and more reliability in Mobile Ad hoc network. Transport Control Protocol,User Datagram Protocol abased traffic models are used to analyze the performance of this protocol and NS-2 simulator is used.

F. New Energy-Efficient MAC Protocol (EE-MAC)

Yongsheng SHI, T. Aaron Gulliver proposed an approach [7] which is helpful in minimizing energy conservation in adhoc networks. Wireless network is a collection of nodes equipped with wireless communications and a networking capability without central network control.Nodes are free to move and organize themselves in an arbitrary fashion. Energy Efficient design is a significant challenge due to the characteristics of MANET such as constantly changing network topology and mobile users having limited power supply. The IEEE 802.11 protocol has power saving mechanism stillhas many limitations. New protocol called Energy Efficient MAC protocol (EE-MAC) is proposed. It shows that EE-MAC performs better than IEEE 802.11 power saving mode and has extra features like balancing network throughput and energy saving.

G. Power Mode Scheduling

The authors Santashil Pal Chaudhuri, David B. Johnson in 2002 [9] proposes two probabilistic algorithms for scheduling transition from idle mode to sleep mode. A mobile ad hoc network is a group of mobile wireless nodes that cooperatively form a network among themselves without any fixed infrastructure. Power scheduling becomes a main issue for these low-power mobile devices. This paper focuses on approach for energy conservation within the routing protocol of the ad hoc network. A wireless network interface in sleep mode expends an order of magnitude less power than in idle mode but in sleep mode no packet is allowed to send or receive.

H. A Modified Energy Saving Dynamic Source Routing

A Modified Energy Saving Dynamic Source Routing in MANETs (MESDSR) has been proposed by authorsShipraGautam , Rakesh Kumar in 1982 [13] which will efficiently utilize the battery power of the mobile nodes in such a way that the network will get more life time. Mobile networks are infrastructure less networks. Power constraint is main design constraint.Therefore every effort is to be made towards reducing power. Network lifetime is a key design metric in MANETs. The mobility rate of nodes is high so use of energy in excess and switching off nodes will cut links between nodes. Ad hoc networks lifetime increases when trafficshould be sent via a route that can avoid nodes with low energy while minimizing the total transmission power. The depletion effects the overall network lifetime not a single node. The focus is to minimise energy conservation within the routing protocols of the ad hoc network.. The simulation was carried out using the NS-2 network simulator.

S. NO	Author/ Proposed By	Year	Algorithm Used	Protocol Used	Findings
1	Alphonsa Xavier1, R. N Gaur2 [1]	2014	Authors proposed thatalthough establishing correct and efficient routes is an important design issue in mobile ad hocnetworks (MANETs), a more challenging goal is to provide energy efficient routes because mobile nodes' operation time is the most critical limiting factor.	Energy Efficient Dynamic Source Routing Protocol	The traditional DSR can also be acted as an energy efficient routing protocol. Because DSR is considered as one of the unconventional routing protocol which does not concerned about energy consumption at all. It has also revealed that a single routing protocol cannot stand strongly against the major constraint of MANET that is power consumption until it is integrated with some other techniques like power consumption, load balancing, transmission control, multi path routing and many more.
2	Dave Yogeshkumar Mukundray1, Amit R.Sharma 2 [2]	2014	Authors implemented an algorithm to maximize the network lifetime by avoiding the routing through nodes with less battery power. In MANET, portable mobile nodes communicate directly with each other without any central infrastructure.. In MANET, resources are limited. Battery power of the node is one of the important resources	Ad hoc On demand Distance Vector (AODV) Routing Protocol	The major design challenge in MANET is energy. A major drawback of AODV protocol is that it is not power aware. Hence routing protocol should be design for power awareness. The algorithm discussed improves the network lifetime by means of increasing the remaining energy of nodes.
3	Akanksha Meshram 1, M .A. Rizvi2 [3]	2013	Authors proposed an approach that reduces energy consumption and prolonging battery life power conservation techniques at various layers and energy efficient routing technique.	Energy efficient Routing Techniques	Energy consumption is an important issue for networking devices. It is one of the most important performance metrics for mobile ad-hoc networks. While it focuses on how the battery life can be prolonged.
4	Shiva Prakash, J.P.Saini [4]	2013	In MANETs, The battery life of the nodes is very limited, if their battery power is depleted fully, then this result in network partition Unbalanced loads turn to increase the chances of nodes failure, network partition and reduce the route lifetime and route reliability of the MANETs. This process is provided by authors for minimization of energy consumption of individual nodes.	Ad hoc Network Routing, Load Distribution, Power Awareness	Limited power supply is the biggest challenge of a mobile infrastructure-fewer networks so if we want to increase the network lifetime (time duration when the first node of the network runs out of energy) as well the node lifetime, an efficient energy protocols which can perform better in all cases of mobility. So, we will choose the protocol in such a way that which perform best for that particular type of network.
5	]S.Rajeswari1 , Y.Venkataramani2 [5]	2012	Authors proposes a new method for energy efficiency and modified Protocol for MANET to achieve energy efficiency and reliability. The probability value can be adaptively adjusted by Radio Activated Switch (RAS) which is embedded in each	Modification Energy Efficient and Reliable Gossip Routing Protocol	The protocol assures the increased delivery ratio and less amount of packet drop that leads to better reliability. This protocol results with low energy consumption for power managed routing. By simulation results, we have shown that the proposed protocol achieves good delivery ratio, less amount of packet drops and less energy

			node.		consumption.
6	Yongsheng Shi, T. Aaron Gulliver [7]	2009	A new energy-efficient MAC protocol (EE-MAC) is proposed which is helpful in minimizing energy conservation in adhoc networks. . Energy-efficient design is a significant challenge due to the characteristics of MANETs such as distributed control, constantly changing network topology, and mobile users with limited power supply.	Energy-Efficient MAC protocol (EE-MAC)	The performance of EE-MAC was evaluated using the NS-2 network simulator, and compared to IEEE 802.11 with and without power saving mode. The results show that IEEE 802.11 performs better than EE-MAC in terms of packet delivery ratio and average packet delay. How-ever, EE-MAC exceeds IEEE 802.11 in energy efficiency and is much better than PSM in overall terms. a mid-sized network with relatively high node density is the best environment to utilize EE-MAC.
7	Santashil PalChaudhuri and David B. Johnson [9]	2002	An ad hoc network is a group of mobile wireless nodes that cooperatively form a network among themselves without any fixed infrastructure. Power consumption within ad hoc networks is becoming a core issue for these low-power mobile devices. Two probabilistic algorithms for scheduling transition from idle mode to sleep mode are proposed.	Adaptive Sleep Algorithm Birthday Sleep Algorithm	Performance evaluation of the strategies show a substantial reduction in power usage, with only a slight decrease in performance.
8	ShipraGautam 1, Rakesh Kumar 2 [13]	1992	The focus is on a technique for minimizing energy conservation within the routing protocols of the ad hoc network. Protocol is proposed which will efficiently utilize the battery power of the mobile nodes in such a way that the network will get more life time.	Modified Energy Saving Dynamic Source Routing in MANETs (MESDSR)	In contrast to simply establishing correct and efficient routes between pair of nodes, one importantgoal of a routing protocol is to keep the network functioning as long as possible. This goal can be accomplished by minimizing mobile node's energy during active communication. Transmission power control and load distributionare two approaches to minimize the active communication energy. The literature survey showed that DSRoutperforms AODV and DSDV in energy per packet consumption. However, the network lifetime of DSDV is better than DSR and AODV.

III. CONCLUSION

Various algorithms have been reviewed. Limited power supply is the biggest challenge of a mobile adhoc networks. So it is necessary to select the protocol that performs best for particular type of network. Energy conservation is the main issue for MANET. It helps to increase the network lifetime. Important goal of a routing protocol is to keep the network functioning as long as possible. The target is achieved by reducing mobile node's energy during active communication.

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