Analysis of Weighted Threshold based Energy Optimization Technique of MANET

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Abstract

Technological modernization has radically changed the communication mechanism. Wireless communications between mobile users is becoming more popular in today's scenario. This is due to technological advances in laptop computers and wireless communication devices. Mobile Ad-hoc Network is infrastructure less wireless network having autonomous nodes connected with each other by means of wireless links. In MANET there is no backbone infrastructure. The system may operate in isolation, or may have gateways to interface with a fixed network. Nodes in the network perform the operation of host node and also acted as routers. Routing in MANET is intrinsically different from traditional routing found on infrastructure based networks. Routing in MANET depends on many factors such as topology, selection of routers, initiation of request and other characteristics that serve as a heuristic in finding the path effectively. Energy consumption is the important factor that impacts the lifetime and routing performance of the network. Clustering schemes provides scalability and topology control in large and dense mobile ad-hoc networks. In this paper, weighted threshold based clustering protocol for energy optimization (THCEP) and lifetime enhancement of nodes of mobile ad-hoc network has been discussed. Performance of threshold based THCEP protocol with AODV protocol has been performed for percentage energy consumption and packet delivery ratio. NS-2 simulator has been used for performing all the simulation work.

Keywords : AODV, THCEP, Packet Delivery Ratio, Energy

1. INTRODUCTION

Mobile Ad-hoc Network is a collection of wireless nodes that dynamically form a network for exchanging information without the aid of any pre-existing fixed network infrastructure. The infrastructure-less approach is increasingly becoming a very important part of communication technology, because in many contexts information exchange between mobile units cannot rely on any fixed network infrastructure, but on rapid configuration of a wireless connections on-the-fly. Ad hoc network have several advantages as compared to traditional cellular system [10,15]. These advantages include On demand setup, Fault tolerance, Unconstrained connectivity etc. Potential applications for this class of network includes instant network infrastructure to support collaborative computing in temporary or mobile environments, emergency rescue networks for disaster management, remote control of electrical appliance, communication systems and mobile access to the global Internet. Topology of the ad hoc network depends on the transmission power of the nodes and the location of the MNs, which may change with time. Mobile network are having limited battery power. Energy optimization is an important issue in Mobile Ad-hoc network[11,16]. Number of protocols has been provided by different researchers for providing optimal energy utilization. Threshold based Clustering

protocol for energy optimization has been discussed and analyzed in further sections. THCEP protocol is weighted clustering protocol. Performance of this protocol has been analyzed for packet delivery ratio and percentage energy consumption with AODV routing protocol. The remaining paper is organized as follows: In Section II, description about AODV routing protocol and THCEP protocol for energy optimization has been provided. Section III provides the energy based comparison of different routing protocols for CBR and TCP traffics. Section V concludes the paper and provides directions for future work.

2. MANET ROUTING PROTOCOLS

Nodes in the Mobile Ad-hoc network are mobile in nature and topology of the network changed with time, so routing packets between any pair of nodes becomes a challenging task. Absence of fixed infrastructure poses several types of challenges for this type of networks [6,9,13]. Major challenges of routing in MANET protocols includes a node needs to know at least the reach ability information to its neighborhood nodes for determining the packet route[16]. Another major challenge includes dynamic nature of Ad-hoc network. Main task of routing protocols is to find the feasible path or route between communicating nodes, based on certain criteria such as hop length, available energy of nodes, and utilizing minimum bandwidth. Routing protocols are required to deal with dynamic topology and other issues in efficient manner. Here, AODV routing protocol and energy based THCEP protocol has been provided.

2.1 Ad-hoc On Demand Vector Routing (AODV)

AODV protocol is reactive routing protocol of Mobile Adhoc Network. In AODV protocol, path has been determined on demand when the node required to send the packets to destination node. So, this routing protocol is also known as On-Demand Routing protocol. AODV protocol utilizes destination sequence numbers to ensure all routes are loop free and contain the most recent route information. Each node maintains its own sequence number, as well as broadcast ID. When a node wants to send the packet to destination node, it broadcasted the route request message (RREQ) to its neighboring nodes in the network. Neighboring nodes then broadcasted this RREQ packet to other neighboring nodes and the process continues till the packet reached to the destination node. While forwarding RREQ message, a reverse path has been established through which the destination node replies back to source node by sending route reply (RREP) packet. When a link breakage in an active route has been detected, a route error (RRER) message is used to inform other nodes in the network about the loss of the link [16].

2.2 Threshold Clustering based Energy Protocol (THCEP)

Clustering mechanism divided the large network into small clusters for topology management. Clustering basically focuses on forming the clusters and maintenance of clusters [6]. THCEP protocol uses energy parameter for defining the clusters. In this protocol residual energy of node has been taken into consideration with other parameters such as hop count and link quality for defining the weight metric for cluster head selection. This protocol defines threshold value based on energy metric. Nodes only with weighted metric value greater than defined threshold value participated in cluster head selection process. This protocol tries to manage the topology of network by defining clusters on the basis of energy metric and threshold value.

3. Results & Discussion

Performance analysis of AODV and THCEP protocol has been analyzed by taking the scenario as shown in table -1 using NS-2 simulator. Performance has been analyzed for packet delivery ratio and energy parameters.

Table-1: Simulation parameters

Parameter	Value
Routing Protocols	AODV, THCEP
Simulation time	500 sec
MAC layer protocol	802.11
Topology size	1000 X 1000
Number of nodes	20, 40, 60, 80
Pause time	10 sec
Mobility Model	Random Waypoint
Speed	40 m/s
Packet Size	512 bytes
Packet Rate	4 packets / sec
Pause Time	0, 4, 8,12
Initial Energy	700 Joules

3.1 Energy Consumption Analysis

When energy consumption of AODV and THCEP protocols has been analyzed for varying number of nodes, observations has been made from simulation results as shown in figure 3.1 that threshold based clustering protocol consumes less energy in comparison to AODV routing protocol for routing of packets.

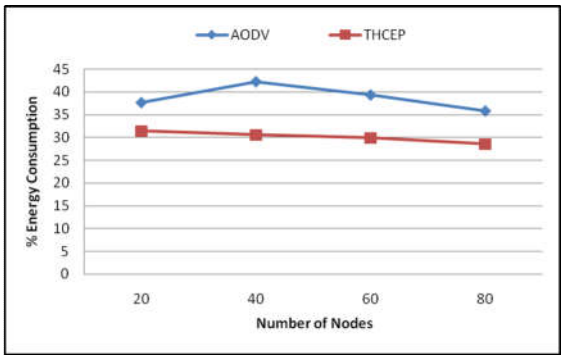

Figure 3.1: Percentage Energy consumption w.r.t number of nodes

Impact of changing pause time values such as 0, 4, 8, 12 seconds on the percentage energy consumption has been shown in figure 3.2. When observing behavior of both protocols for varying pause time it has been seen that for lower pause time energy consumption of THCEP protocol is less but when observed for higher pause time values it has been observed that AODV consumes less energy in comparison to THCEP protocol.

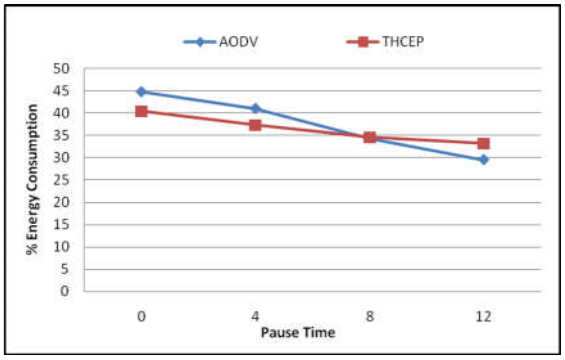

Figure 3.2: Percentage Energy Consumption w.r.t pause time

3.2 QoS Analysis

Packet delivery ratio of AODV and THCEP protocol for varying number of nodes has been shown in figure 3.3. It has been observed from this figure that increasing number of nodes improves the packet delivery ratio of both protocols. When observing for AODV protocol, packet delivery ratio is approx. 95% to 97% whereas when considering THCEP protocol, it varies from approx. 88% to 94%.

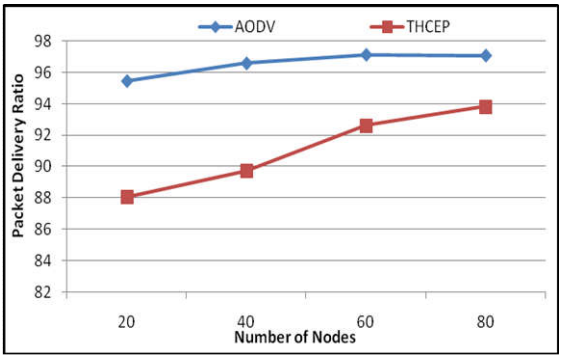

Figure 3.3: Packet Delivery Ratio w.r.t number of nodes

When Packet delivery ratio of AODV and THCEP protocols has been analyzed for varying pause time such as 0, 4, 8, 12 seconds, observation as depicted in figure has been made. From the analysis of this figure, it has been concluded that AODV protocols results in 90% to 95% successful delivery of packets. However when considering THCEP protocol, it has been observed that there is approx. 70% to 80% successful delivery of packets.

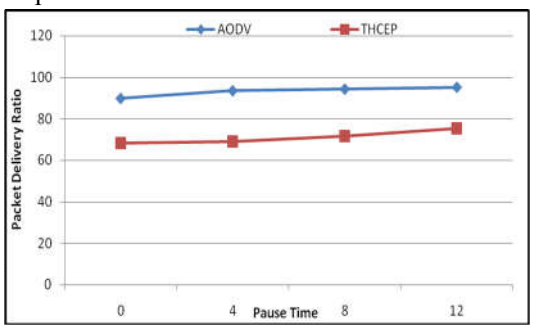

Figure 3.4: Packet Delivery Ratio w.r.t pause time

It has been concluded at all from above analysis of packet delivery ratio that AODV protocol provides better packet delivery ratio in comparison to THCEP protocol.

4. Conclusion And Future Study

In this paper, analysis has been performed for energy consumption and packet delivery ratio of AODV protocol and THCEP protocol for varying number of nodes and pause time. It has been concluded that adapting threshold based clustering mechanism for energy optimization provided energy improvements and enhances the lifetime of nodes. It has also been concluded that THCEP protocol degrades the successful packet delivery to the destination node. In future, there is need to provide an efficient energy efficient mechanism that provides energy improvement as well as enhances QoS performance.

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Author's Profile

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