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RESEARCH ARTICLE

COMPARATIVE STUDY OF NODE ENERGY CONSTRAINTS FOR MANET ROUTING PROTOCOLS

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Abstract—Ad-hoc routing technology has been developed primarily for networks of mobile nodes. Mobile nodes have limited battery energy, when a battery discharges then it becomes very difficult to recharge or replace the battery of the nodes. These nodes need to be energy conserved to maximize the battery life as well as lifetime of nodes. The routing protocols affect the performance of the mobile node energy. There are three types of routing Protocols i.e. Proactive, Reactive and Hybrid Routing protocols. We have considered one protocol from each type: AODV, ZRP & STAR. By using the protocols in mobile ad hoc networks the energy performance metrics, routing power and residual energy in all the three modes (transmitting, receiving, and idle) are evaluated. The other performance metrics of application layer are also evaluated i.e. throughput and average jitter. The simulation has been carried out using QualNet 5.0.2. Finally, the observations are compared and the impact of energy constraints on a node in physical layer of the networks the STAR protocol offers the best combination of energy consumption and throughput performance

Keywords: Wireless Sensor Network; TCP; throughput; delay; jitter; Qualnet

I. INTRODUCTION

MANET consists of mobile platforms have a router with multiple hosts and wireless communications devices .herein simply refer to as nodes which are free to moves randomly. These nodes may be located in any moving vehicles such as ships, trucks, cars, airplanes, even on people or very small devices, and there may be as many hosts per router. A Mobile Ad hoc Network is an independent system of mobile nodes. The system may operate in remote locations, or may have gateways and to maintain interface with a permanent network. Without a fixed infrastructure, an ad hoc network depends on portable, limited power sources. Energy efficiency of the network is a major issue; as a result it becomes one of the most important problems in ad hoc networks. Energy can be consumed during

processing and communication. The energy consumed during processing is less when compared to the energy consumed during communication. So, the communication system must be energy efficient to optimize the energy consumption at different states of the communication. The wastage of battery power decreases the lifetime of the wireless nodes. A general constraint of wireless communication is the short lifetime of mobile terminals, since batteries provide limited power to operate the nodes. Hence, power management is one of the most challenging problems in wireless communication. In this paper performance of three different types of routing protocols are compared with scenarios of different number of nodes (10, 20, 30, 40, 50) using QualNet Simulator from Scalable Networks platform to perform simulations. The simulator setup and finally the results are discussed.

II. PROTOCOLS ANALYSED

The following protocols are considered for analysis:

- AODV
- STAR
- ZRP

A. Adhoc on demand routing (AODV)

AODV has a routing table and all of them will be assured by a series of numbers. The routing table is updated when all node receives the control packet. The AODV routing protocol is mainly developed for ad hoc mobile networks. It is able to handle unicast and multicast routing. The AODV is working only on demand. It has quite a few advantages, specifically; they are loop free and self starting. The AODV develop a route using two routers one for route reply and another one is for route request. The route is maintained only at the time when it is being used by the router and if it is not maintained accurately the probability of getting expired is more.

This protocol is completely based on source-initiated on-demand routing. Only when the source node desired the routes have been created. Source when it demands the route discovery process starts. This procedure is completed once a route is found or each and every one possible routes have been explored. It provides unicast, broadcast, along with multicast communication in networks. Routes are maintained as extended they are wanted by the source node. AODV nodes maintain a route table in which next hop routing information for destination nodes is stored.

B. *Source tree adaptive routing protocol (STAR)*

The Source Tree Adaptive Routing (STAR) is a table-driven, link-state protocol that can be run with an emphasis on a small routing overhead measured as network load. The STAR protocol is intended for use by nodes (static and mobile) in an ad hoc network or an internet. A router in STAR communicates to its neighbors the parameters of its source routing tree consists of each and every link that the router needs to reach the known destination (and address range) in the ad hoc network or internet. To conserve energy and transmission bandwidth, a router communicates changes to its source routing tree only when the router detects new destinations, the possibility of network partitions, or the possibility of node failures or network looping. The STAR routing protocol can be run either by using an optimum routing approach (ORA) or by using a least overhead routing approach (LORA). The first approach tries to fulfil a requirement to provide optimal paths between nodes in accordance with a defined metric and will not consider the volume of routing messages - in fact its performance characteristics will depend on the frequency of routing tables updates. On the other hand, the LORA approach in accordance with its name strives to keep the overhead of routing messages to a minimum while sacrificing the optimality requirement of ORA. In STAR, each router *i* maintains a Topology Graph (TG), i.e. a view of the network that is formed by aggregating the router's knowledge of its adjacent links and information gathered from its neighbouring routers. Based on *TGi* the router runs a route selection algorithm and constructs a Source Tree (ST), which consists of all preferred paths to all nodes known to the router. For every node *j* known to *i* there is an entry in the routing table stating the first hop (the successor) in the path.

C. Zone routing protocol (ZRP)

The zone routing protocol (ZRP) will be provides a frame work for additional process. The size of the zone is depending on strength of the signal and power which is accessible nodes consistency etc. Zone Routing Protocol or ZRP was the initial hybrid routing protocol it has both proactive and reactive routing section. The ZRP has been

used to reduce the control overhead of proactive routing protocols and decrease the latency caused by route discovery in reactive routing protocols. The ZRP defines a zone in the region of every node which consists of the node's k-neighborhood (that is, every node inside k hops of the node). For within the routing zones the intra zone routing protocol is measured. There are two types of zone routing protocol they are intra zone routing protocol and inter zone routing protocol. The inter zone routing protocol is used in among the nodes.

III. SIMULATION ENVIRONMENT

The simulation process of MANET is implemented using simulator Qualnet 5.0.2. Performance metrics used in this paper are Throughput, Average jitter, Energy consumed in transmit and receive mode and percentage of time in transmit and receive mode.CBR (Constant bit rate) application is used for in the scenarios. The no: of nodes used in the scenarios are 10,20,30,40 and 50. At last result is achieved for different scenarios and the three routing protocols are compared.

TABLE I
SIMULATION PARAMETERS

Scenario Setup	**Value**
No of Nodes	10, 20 , 30, 40, 50
Simulation Area	1500 * 1500
Simulation Time	30 Seconds
Mobility Model	Random Way Point
Node Speed	10m/s
Routing Protocol	AODV,STAR, ZRP
Propagation Model	Two Ray Ground
Traffic Type	CBR
Packet Size	256 bytes
Generic Energy Model Parameters	**Value**
Energy Model	Generic
Energy supply Voltage	6.5 Volt
Transmit Circuitry Power Consumption	100.0 mW
Receive Circuitry Power Consumption	130.0 mW
Idle Circuitry Power Consumption	120.0 mW
Sleep Circuitry Power Consumption	0.0 mW

The scenario for AODV, STAR and ZRP with 50 nodes is shown in figure 1. All the scenarios have a terrain of 1500 * 1500.

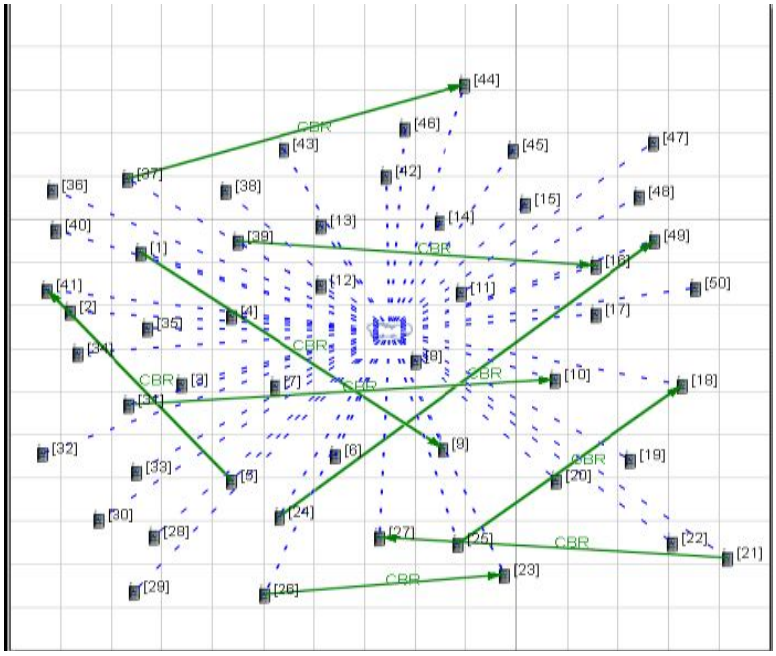

Fig. 1 Scenario with 50 nodes

IV. PERFORMANCE METRICS

The following parameters are analyzed and comparison is made for the above routing protocols

- Average jitter
- Throughput
- Energy Consumed in transmit mode
- Energy Consumed in receive mode
- Percentage of time in transmit mode
- Percentage of time in receive mode

V. SIMULATION RESULTS

A. Throughput

Throughput performance is high for AODV when compared to STAR protocol.ZRP performance is very poor.

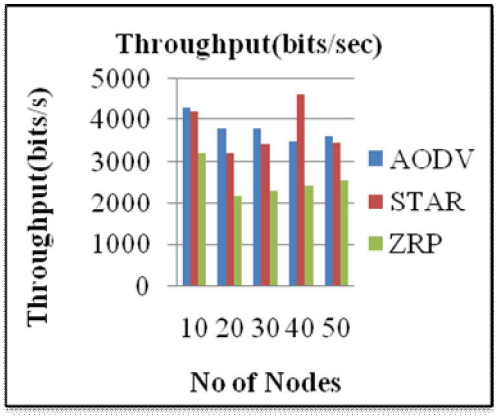

Fig. 2 Throughput versus Number of nodes

B. Average Jitter

From the graph the average jitter is low for STAR while using less nodes as well as more nodes. AODV has high value of average jitter.

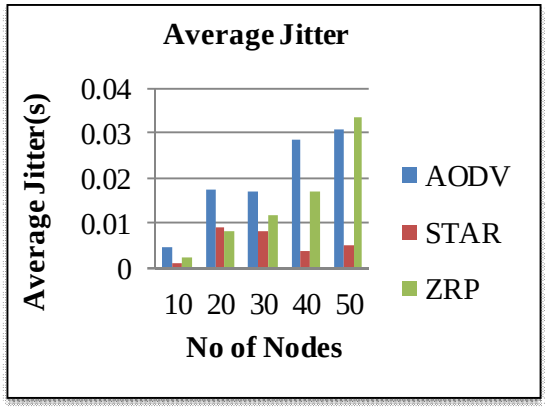

Fig. 3 Average Jitter Versus Number of Nodes

C. *Energy Consumed in Transmit Mode*

Energy consumption in transmit mode is very low for STAR protocol when compared to the other two.

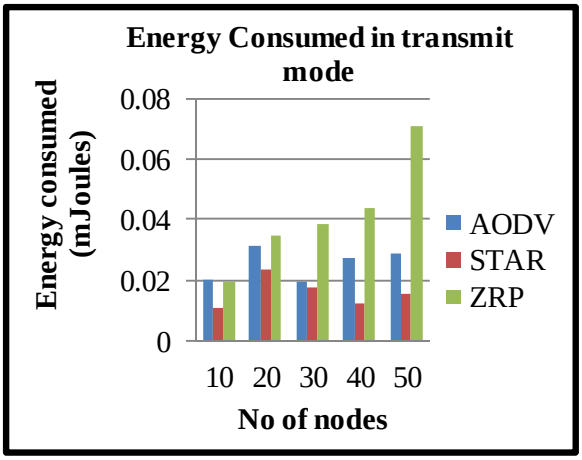

Fig. 4 Energy consumed in transmit mode

D. Energy Consumed in Receive Mode

STAR routing protocol consumes less power than other protocols in receive mode.

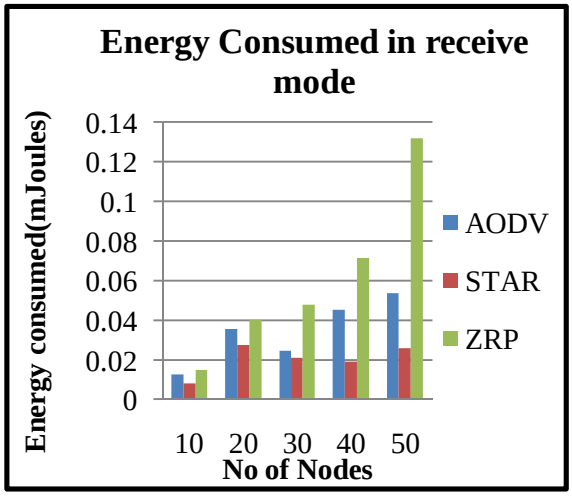

Fig. 5 Energy consumed in receive mode

E. Percentage of time in Transmit Mode

Percentage of time taken by STAR routing protocol is less when compared to other protocols.ZRP takes much time when compared to AODV and STAR.

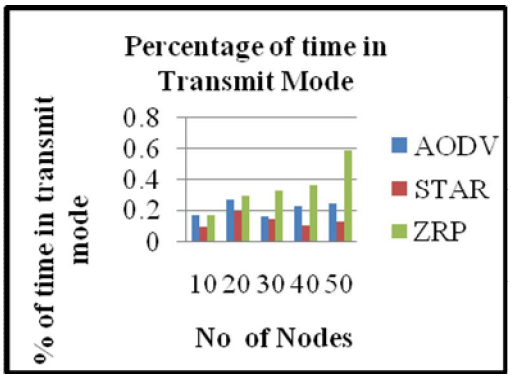

Fig. 6 Percentage of time in Transmit Mode

F. Percentage of time in Receive Mode

Percentage of time consumed by STAR protocol in receive mode is less when compared to other protocol.

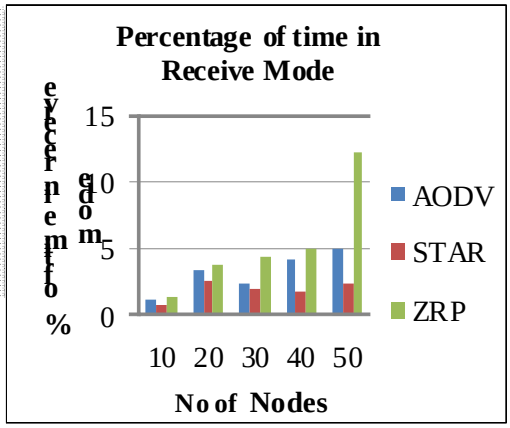

Fig. 7 Percentage of time in receive mode

VI. CONCLUSION

Energy saving is an important optimization objective in Mobile Adhoc Network, the energy consumed during communication is more dominant than the energy consumed during processing because of Limited storage capacity, Communication ability, computing ability and the limited battery are main restrictions in sensor networks. By the observations we compare that the impact of energy constraints on a nodes in physical layer and application layer of the networks that STAR offers the best combination of energy consumption and throughput performance. STAR gives better throughput, average jitter and delay performance compared to ZRP followed by AODV. If we increased numbers of nodes also increase maximum energy consumption in STAR followed by ZRP then AODV due to routing control packets in the network. Future work, we can reduce the waste energy consumption of the nodes by reducing the number of routing control packets and reducing the energy consumed by nodes in a large network to increase the life time of network.

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