Analysis of Energy Consumption in Ad-Hoc on Demand Distance Vector (AODV) Protocol

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ABSTRACT
In Mobile Ad-Hoc Networks (MANETs), mobile devices are equipped with power (energy). In order to utilize this energy equipped devices efficiently for transmission of data packets, many energy aware routing strategies are followed. As a key note to these routing strategies, the energy aware performance metrics are analyzed reactive routing protocol Ad-Hoc on Demand Distance Vector Protocol (AODV). The comparison results prove that AODV protocol can be adopted for any routing strategy, in order to increase the performance of the network lifetime in comparison.

Keywords
Mobile Ad-Hoc Network, MANET Routing Protocols, AODV.

1. INTRODUCTION
Mobile Ad-Hoc networks (MANETS) are self-configured and infrastructure less network with more number of mobile devices connected via a wireless links. Energy conservation in ad-hoc networks is very important due to the limited energy availability in each wireless node [7]. Since the communication between two wireless nodes consumes more energy, it is important to minimize the cost of energy required for communication by exercising an energy aware routing strategy. Such routing procedures/policies potentially increase the lifetime of the network. In this paper, the energy metrics of AODV is compared by simulating with increasing the density of nodes.

2. MANET ROUTING PROTOCOLS
Routing protocols is a standard that controls how nodes decide to route the packets between the source and the destination node. Each node learns about nodes nearby and how to reach them. The routing protocols find a route for packet transmission and will transfer the packet from source to destination. The routing protocols are mainly classified in two ways.1.Table Driven protocols or proactive protocols 2.On-Demand protocols or reactive protocols. Table-driven routing protocols are trying to maintain consistent, routing information from each node to every other node in the network [2]. Each node is maintaining one or more tables that containing routing information about every other node in the network. Examples for table driven protocols are: Destination Sequenced Distance Vector Routing Protocol (DSDV), Wireless Routing Protocol (WRP), and Cluster Switch Gateway Routing (CGSR) [2]. The On-Demand protocols will establish the route between the nodes that they want to communicate. When a source node requires a route to destination node, it initiates a route discovery process in the network. This process is completed once a route is found or all possible route permutations have been examined [2]. The route remains valid until the route is no longer needed. Examples of On-Demand routing Protocols are Relative Distance Microdiversity Routing (RDMR), Temporally Ordered Routing Algorithm (TORA), Dynamic Source Routing (DSR), Ad-Hoc On Demand Distance Vector Protocol (AODV) [2].

3. AODV
The Ad-Hoc On-Demand Distance Vector routing protocol is a reactive routing protocol. AODV protocol is a combination of Dynamic Source Routing (DSR) and DSDV protocol [5]. It is a distance vector routing protocol and is capable of both unicast and multicast routing [8]. It will maintain the routes only between the nodes which need to communicate. The routing information will be maintained as routing tables in each node. A routing table entry expires if it has not been used or reactivated for pre-specified expiration time. When a source node wants to send the packet to a destination node then the entries in the routing table will check whether there is a current route to the destination node or not, if there is a route then the packets will transmit to destination node in that path [2]. If don't have any valid route, then the route discovery process will be initiated. For route discovery AODV is using Routing Request (RREQ), Routing Reply (RREP) Packets [1]. The RREQ packet containing the source node IP address, source node current sequence number, the destination node sequence number and broadcast ID [1][8]. The advantage of AODV is that it creates no extra traffic for communication along the existing link but requires more time to establish a connection. It is simple and doesn't require much memory or calculation.

4. SIMULATION MODEL
A discrete event Omnetpp 4.3 was used for the simulation purpose [6].

Table 1. Simulation Perameters

Channel type	**WirelessChannel**
Radio-propagation Model	**TwoRayGround**
Antenna type	**OmniAntenna**
Interface queue type	**Drop Tail /PriQueue**
Maximum packet in Queue	**50**
Network interface type	**Phy/WirelessPhy**
MAC type	**802_11**
Topographical Area	**600 x 600 m**

TxPower	**4.00W**
RxPower	**3.00W**
IdlePower	**1.0W**
Transition Power	**0.01W**
Transition Time	**0.003s**
Sleep Power	**0.004W**
Total simulation Time	**600 ms**
Initial energy of a Node	**300.0 Joules**
Routing protocols	**AODV**
Traffic Model	**FTP**
Packet Size	**1024 Bytes**
Mobility Speed	**10 m/s**

4.1.Metrics Analyzed for simulation

This is the number of data packets that are sending from source to destination during the transmission. In this study the total number of data packets sent by the source within the simulation time is calculated.

Consumed Energy

The number of nodes in the network versus the total consumed energy is considered as a metric.

Remaining Energy

The remaining energy available in each node after the transmission.

Delivery Fraction [PDF]

This is the ratio of the data packets delivered to the destination to those generated by the traffic source.

Routing Overhead

Routing overhead [9] is the number of routing packets transmitted per data packet delivered to the destination.

Normalized Routing Load [NRL]

This will be the ratio between the number of routing packets and the number of received packets. The Normalized Routing load must be low.

Throughput

It is the average rate [10] of successful message delivery over the communication channel.

5. RESULT AND DISCUSSION

Table 2. Energy Consumption

No. of Nodes	Sent packets	Received packets	Remaining Energy	Consumed Energy
10	1335	1315	312.1986	2687.8013
20	3568	3552	1780.2018	3219.7983
30	2026	2006	1688.3478	5311.6523
40	3656	3647	724.77563	8275.225
50	3212	3212	2559.7375	8440.263

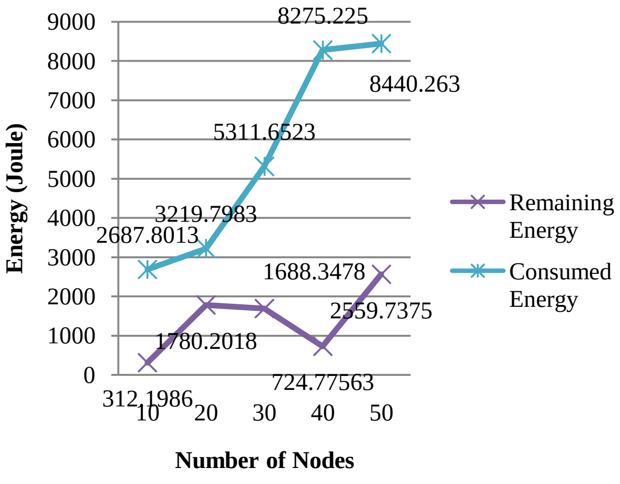

Fig.1 Energy Consuption

Table 3. Compariotion of different aspects

No. of Nodes	PDF (%)	NRL (%)	Routing Load (bits)	Throughput (Kbps)
10	98.5018	0.78631	1034	143.29
20	99.5515	0.00732	26	679.37
30	99.0128	0.05533	111	307.76
40	99.8085	0.13456	491	545.77
50	100	0.03518	113	471.97

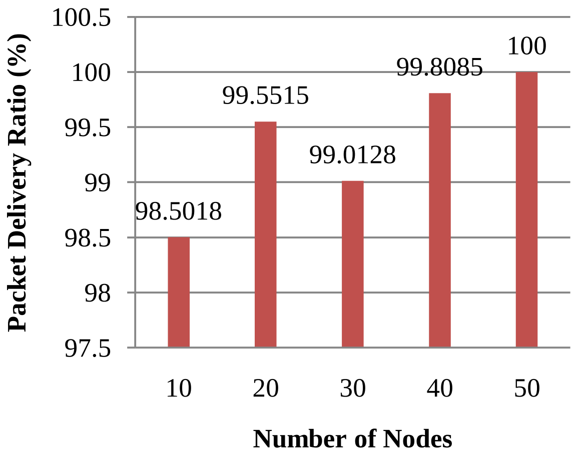

Fig 2. Packet Delevery Ratio of AODV

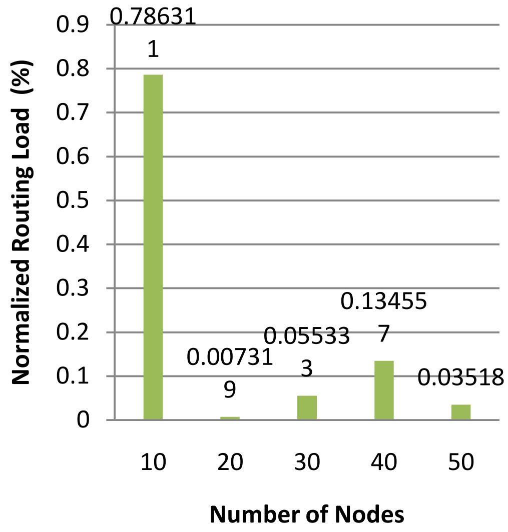

Fig 3. Normalized Routing Load of AODV

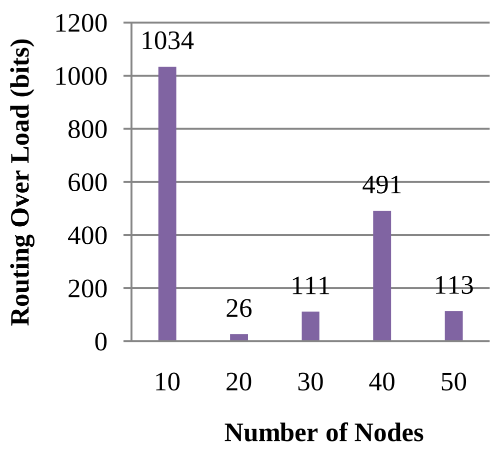

Fig 4. Routing Over Load of AODV

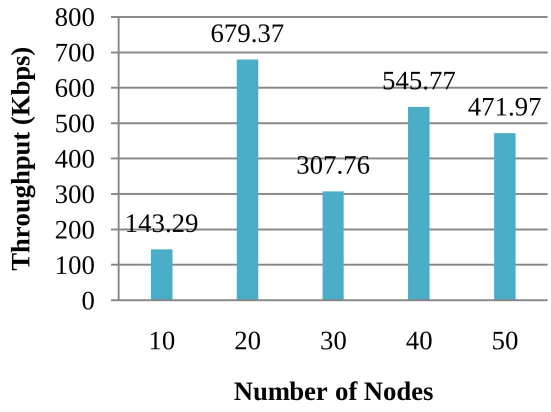

Fig 5. Throughput of AODV

6. CONCLUSION

The various energy-aware parameters are analyzed in Omnetpp 4.3 for AODV protocol by increasing the density of nodes. It is concluded that, AODV performs well in Packet Delivery Fraction (PDF) but in some situations due to link breakage the PDF is low. Since AODV requires less energy for transmission of packets. As the remaining energy of nodes are calculating AODV. It is advantages not to use the nodes with minimum remaining energy in order to avoid stale nodes in the network. In future the missing facility regarding energy saving technique in AODV has to overcome.

7. REFERENCES

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