Performance Analysis based on Energy Efficiency of AODV & DSR Routing Protocol in MANETs

Nitin K
ECE Dept.
GNDEC Bidar

Rahul K
CSE Dept.
GNDEC Bidar

***Abstract*—Mobile Ad Hoc Networks (MANETs), without any fixed infrastructures, allow mobile nodes to set up a temporary network for instant communication. Energy consumption is an important issue in manets. Various studies have considered nodes with infinite energies but in real life scenario, each node in manets are battery powered devices with limited energy. Here we compare the performance of AODV & DSR protocol considering nodes with limited energies. The performances are measured using the metrics like number of node terminations, packet delivery and relative energy consumption. The performance of the protocols has been analyzed using simulations in ns-2.**

Keywords—Energy efficiency, AODV, DSR, NS2

I. INTRODUCTION

With the proliferation of mobile devices such as cell phones, laptops, tablet PCs, personal digital assistants (PDAs), digital cameras etc., the demand for continuous network connectivity regardless of the physical location has spurred interest in mobile networks. Over the decades, the use of these personal communication devices has taken an exponential growth. In addition, these devices are getting smaller, cheaper, more user friendly and more powerful. Mobile Ad Hoc Networks (MANETs) are collection of mobile nodes forming a temporary spontaneous network without the aid of any centralized administration. Hence, MANETs bear great application potential in these scenarios, including disaster and emergency relief, mobile conferencing, battle field communication, and so on.

Various performance analysis of Manets protocols have been done in the past [2, 5] but have considered nodes with infinite energy. Practically Manet nodes have limited energies as they are battery powered devices and shut down after having exhausted them. These node terminations are going to affect the packet delivery ratio, end to end delay. Further, the protocol choice affects the routing overhead, which in turn affects the energy consumption, and thus the node and network lifetime. In this paper, we have chosen on-demand routing instead of table-driven routing because it has been shown [2, 3] that on-demand routings outperform table-driven routings under various cases. We selected two typical on-demand routings, DSR and AODV, in our performance comparison because they have been widely studied and adopted by MANET researchers. In our simulations, we consider nodes with limited energies, which terminate once the energy is exhausted, just like in a real-life scenario. The performances are measured using the metrics like number of node terminations, packet delivery and relative energy consumption. The rest of the paper is organized as follows: The DSR routing protocol Description is summarized in section II. The AODV routing protocol Description is summarized in section III. The simulation models and performance metrics are described in Section IV.

II. DYNAMIC SOURCE ROUTING PROTOCOL (DSR)

The Dynamic Source Routing (DSR) protocol [1][2][3][5][8][9] is an on-demand protocol and employs source routing. That is, the sender knows the complete hop-by-hop route to the destination. These routes are stored in a *route cache*. The data packets carry the source route in the packet header. When a source node desires to send a packet to a destination node, it first searches its Route Cache for a previously learnt valid route. If such a route is available, it is used to send the packet. If not, the node initiates the Route Discovery process by broadcasting a Route Request packet (RREQ). Each node receiving an RREQ rebroadcasts it, unless it is the destination or it has a route to the destination in its route cache. Such a node replies to the RREQ with a *route reply* (RREP) packet that is routed back to the original source. The RREQ builds up the path traversed across the network. The RREP routes itself back to the source by traversing this path backward. The route carried back by the RREP packet is cached at the source for future use. If any link on a source route is broken, the source node is notified using a *route error* (RERR) packet. The source removes any route using this link from its cache. A new route discovery process must be initiated by the source if this route is still needed.

III. ADHOC ON-DEMAND DISTANCE VECTOR ROUTING PROTOCOL (AODV)

The Ad hoc On-demand Distance Vector (AODV) routing protocol [2-5][8][9] is a pure on demand route acquisition protocol. Every node in the network maintains a Route Table, which contains one route entry for each known destination node in the network. AODV uses sequence numbers maintained at each destination to determine freshness of routing information and to prevent routing loops. These sequence numbers are carried by all routing packets. In addition, each route entry records the Hop Count (the number of hops needed to reach this particular destination) and Next Hop. When a node wants to send a packet to a destination node, it checks its Route Table for a valid route to the destination. If it finds one, it sends the packet to the Next Hop recorded in the route entry for that destination. If not, it initiates a Path Discovery process, by broadcasting a Route Request (RREQ). An intermediate node processing the

RREQ first increments the Hop Count by one. It then generates a Route Reply (RREP) if it is either the destination or has a fresher route to the destination (as indicated by the Destination Sequence Number in the route entry). If the node is not the destination, the Next Hop is set to the neighboring node from which this node received the RREQ, and the Hop Count is set to the value mentioned in the RREQ. Finally, the node broadcasts the RREQ. The nodes are notified with RERR packets when the next-hop link breaks. Each predecessor node, in turn, forwards the RERR to its own set of predecessors, thus effectively erasing all routes using the broken link.

IV. SIMULATION MODELS AND PERFORMANCE METRICS

A. Simulation Models

The NS-2 simulator, version 2.35, with wireless extension [6] is used for simulating the performance of two routing schemes: AODV and DSR. NS-2 can simulate the physical, MAC and data link layer of a multihop wireless network. The distributed coordination function (DCF) of IEEE 802.11 for wireless LANs is utilized as the MAC layer [6]. Lucent's WaveLAN is used as the radio model, which is a shared-media radio with a nominal bit rate of 2Mbps and a nominal transmission range of 250 m. With the use of a NS-2 simulator, we can correctly model the effects of contention for the media and the distance between mobile nodes in determining whether a transmitted packet will be successfully received.

Random waypoint model [7] is adopted for simulating movement behaviors of all mobile nodes in our experiment. We generate CBR traffic with the ''cbrgen'' tool and scenario with the "setdest" tool in NS2 [6]. The size for each data packet is 512 bytes and the packet generation rate is 4 data packets per second. Table I shows the default parametric values used in the simulations. In order to make our simulation results more reliable, a number of simulation runs (more than 5 runs for each point) have been made.

The energy is consumed in transmission, reception, idle and sleep modes according to the NIC specifications. Specifically, transmission consumes energy in modulation and subsequent amplification; reception consumes energy for RF power amplification, demodulation and subsequent base band amplification; idle mode consumes energy for carrier sensing: and the sleep mode consumes energy for maintaining sleep-wake cycle. The nodes in our model have finite and equal energies, initialized to 25 J at the start of the simulation. When the node's energy is exhausted, its network interface becomes inoperational. Such a node is called a dead node.

TABLE I. SIMULATION PARAMETERS

Parameters	Values
Simulation time	300 s
Number of mobile nodes	25
Simulation area	1000 m*200 m
Transmission range for mobile nodes	250 m
Pause time for mobile nodes	0.0s
Max. Speed for mobile nodes, Vmax	15 m/s
Speed for mobile nodes	Uniformly distributed between 0 - Vmax
Traffic pairs	5,10,15,20
Data Traffic Rate for each source	4 packets/second
Propagation Model	Two ray ground
Node Movement Model	Random waypoint
MAC	IEEE 802.11
Initial Energy of nodes	25 J
Transmit Power	0.66 W
Receive Power	0.395 W

B. Performance Metrics

Following are the metrics which are measured.

1. Relative Energy Consumption: this metric is a comparison between the energy attributed to transmitting and receiving the data packets (CBR energy) and that attributed to the routing protocol packets (RTR energy). It measures the overhead posed by the protocol, in terms of energy. We calculate the energy attributed to both the data and routing packets, by counting their respective numbers at the network layer. This is done so that packets that are forwarded (and eventually consume energy) may also be counted.

*TxCBR Energy= Transmit power * Packet Size(bits) / Bandwith(bps)*
*RxCBR Energy= Receive power * Packet Size(bits) / Bandwith(bps)*
Total RTR Energy= TxRTR Energy + RxRTR Energy

2. Number of Dead Nodes: it is the number of nodes in the network that terminate due to complete exhaustion of energy by the end of the simulation. This metric indicates the effect of the protocol choice on network and node lifetime.

3. Packet Delivery Ratio (PDR): it is the ratio of the number of (data) packets received to the number of (data) packets sent in the entire network. Being an end-to-end metric, it is calculated on the basis of the packets sent or received at the application layer.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 06, June-2016

V. SIMULATION RESULTS

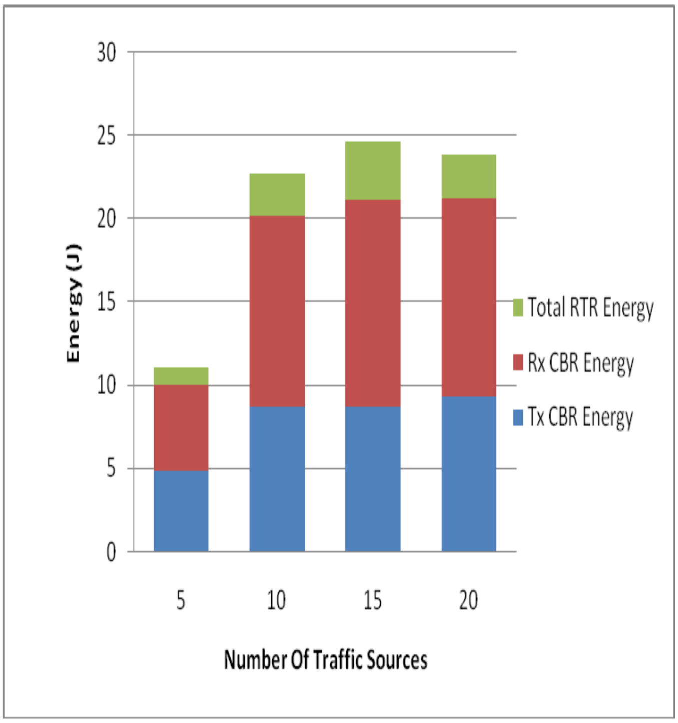

Figure 1: Relative energy consumption for AODV

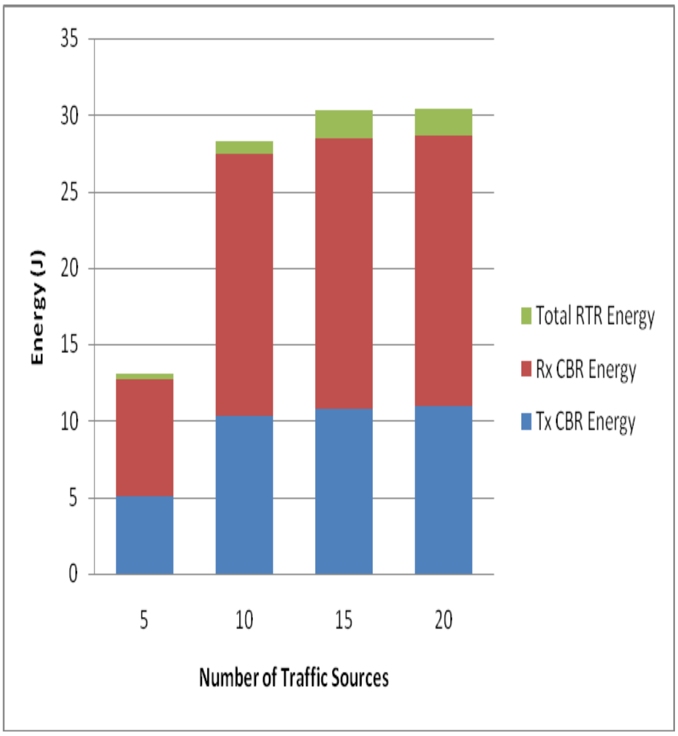

Figure 2: Relative energy consumption for DSR

Figure 3: Packet Delivery ratio

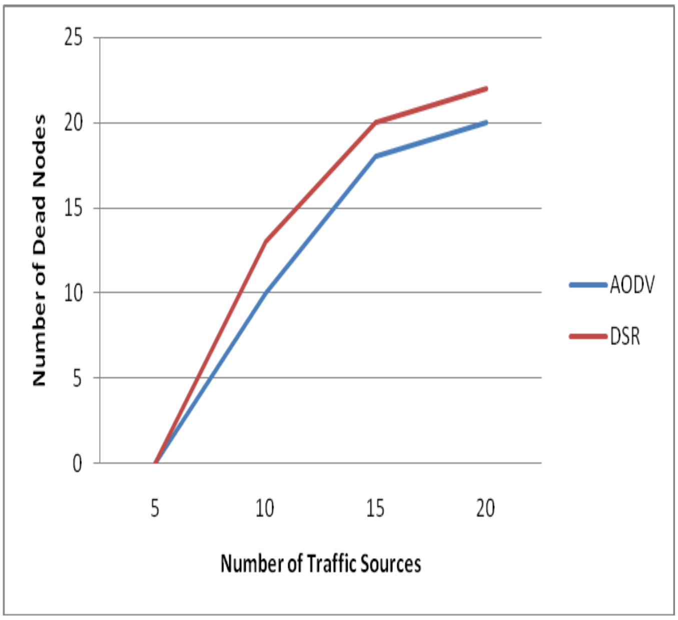

Figure 4: Number of Dead Nodes

VI. CONCLUSION

In this paper we have analyzed the performance of energy efficiency of AODV & DSR routing protocol. We have considered nodes with limited energies. In Figs 1 & 2 each section of the bar depicts the total energy consumed for a specific operation. The energy consumed is proportional to the number of bits transferred. The total number of bits transferred is also proportional to the total number of packets transferred. DSR poses a considerably lesser routing overhead than AODV. DSR is also able to send and receive a greater number of data packets than its counterpart. The size of data packets (512 bytes) is much larger than that of any routing packet (between 40-60 bytes). Thus, the transmission and reception of data packets consumes much more energy than that consumed by routing packets (Figs 1 & 2). The total energy consumed is the sum of the energies consumed by the data and routing packets. DSR is capable of

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 06, June-2016

sending and receiving a much greater number of data packets than AODV (Figs 1 & 2). This implies that even though DSR has a much lesser routing overhead than AODV, the overall energy consumption is much greater. Thus more nodes terminate as their energies get exhausted when DSR is used.

REFERENCES

[1] David B Johnson, David A Maltz & Yih-Chun Hu. The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks (DSR), *IETF Internet Draft, draft-ietf-manetdsr-10.txt.* 2004.

[2] J. Broch, and D. A. Maltz, et al., A performance comparison of multi-hop wireless ad hoc network routing protocols. In Proc. Of the 4th Annual ACM/IEEE International Conference on Mobile Computing and Networking, pp. 85–97, 1998.

[3] A. Boukerche, Performance evaluation of routing protocols for ad hoc wireless networks, Mobile Networks and Applications, Vol.9, pp. 333–342, 2004.

[4] C. E. Perkins, E. M. Royer, and S. R. Das, Ad Hoc On- Demand Distance Vector (AODV)Routing, Internet Draft, draft-ietf- manet-aodv-10.txt, work in progress, 2002

[5] C. E. Perkins, E. M. Royer, S. R. Das and M. K. Marina, Performance comparison of two on-demand routing protocols for ad hoc networks, IEEE Personal Communications, Vol. 8, pp. 16–28, 2001.

[6] K. Fall and K. Varadhan, ‘‘The ns Manual’’ The VINT Project, UC Berkeley, LBL, USC/ISI, and Xerox PARC. http://www.isi.edu/nsnam/ns/doc/index.html, March 2008.

[7] T. Camp, J. Boleng and V. Davies, A survey of mobility models for ad hoc network research, Wireless Communications and Mobile Computing, Vol. 2, pp. 483–502, 2002.

[8] A. Boukerche, "Simulation based performance comparison of routing protocols for mobile ad hoc networks", Simulation, Vol. 78. Issue 7, July 2002, pp. 401-407.

[9] E. M. Royer and C. K. Toh, "A review of current routing protocols for ad hoc mobile wireless networks", IEEE Personal Communications magazine, April 1999, pp. 46–55.