

“Evaluation of LANMAR and DSR Ad hoc Routing Protocol for various Battery models in MANET using Qualnet”

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Abstract

Mobile Ad Hoc Network (MANET) is collection of multi-hop wireless mobile nodes that communicate with each other without centralized control or established infrastructure. The wireless links in this network are highly error prone and can go down frequently due to mobility of nodes, interference and less infrastructure. The DSR, LANMAR protocols are compared for battery models DURACELL AA (MX 1500), PANASONIC AA, PANASONIC AAA, Duracell MN 2400, DURACELL MX2400 standard using Qualnet as a Simulation tool. Hence performance of the protocols with various battery models counts and helps to make a right selection.

Keywords: MANET, QUALNET, LANMAR, DSR

1. INTRODUCTION

A MANET is a collection of mobile nodes (MNs) that communicate with each other without the use of any fixed infrastructure. Every MN in the MANET has the role of both the router and the user, in which communication is performed through multi-hop routing. In addition, nodes may arbitrarily participate or withdraw from the MANET, and has no restriction on their mobility. In terms of deployment cost and difficulty, MANETs have efficiency in areas such as campus networks, extension of access point coverage, disaster areas, or a place for casual events like concerts or festivals. In general the two types of wireless sensor networks are: unstructured and structured. The structured wireless sensor networks are those in which the sensor nodes deployment is in a planned manner whereas unstructured wireless sensor networks are the one in which sensor nodes deployment is in an ad-hoc manner. As there is no fixed infrastructure between wireless sensor networks for communication, routing becomes an issue in large number of sensor nodes deployed along with other challenges of manufacturing, design and management of these networks. There are different protocols that have been proposed for these issues. The critical condition monitoring application is studied in this thesis by evaluation of two routing protocols with the help of some performance metrics considering applications demand as well.

2.1 Types of routing protocols

2.1.1 Proactive routing protocol Proactive routing protocols maintain information continuously. Typically, a node has a table containing information on how to reach every other node and the algorithm tries to keep this table up-to-date. Changes in network topology are propagated throughout the network

2.1.2 Reactive (on demand) routing protocols On demand protocols use two different operations to Route discovery and Route maintenance operation. In this routing information is acquired on-demand. This is the route discovery operation. Route maintenance is the process of responding to change in topology that happen after a route has initially been created

2.1.3 Hybrid routing protocols Hybrid routing protocols are a new generation of protocol, which are both are Proactive and Reactive in nature. Most hybrid protocols proposed to date are zone based, which means that the network is partitioned or seen as a number of zones by each node. Normally, Hybrid routing protocols for MANETs exploit hierarchical network architectures.

2.2 The protocols studied here are :

2.2.1 Landmark Ad-hoc routing(LANMAR)

This protocol combines properties of link state and distance vector algorithm and builds subnets of groups of nodes which are likely to move together [15]. A Landmark node is elected in each subnet, similar to FSR. The key difference between FSR protocols is that LANMAR routing table consists of only the nodes within the scope and landmark nodes whereas FSR contains the entire nodes in the network its table. During the packet forwarding process, the destination is checked to see if it is within the forwarding node's neighbor scope. If so, the packet is directly forwarded to the address obtained from the routing table. On the other hand, if the packet's destination node is much farther. The packet is first routed to its nearest landmark node. As the packet gets closer to its destination, it acquires more accurate routing information, thus in some cases it may bypass the landmark node and routed directly to its destination. The link state update process is again similar to the FSR protocol. Nodes exchange topology updates with their one-hop neighbors. A distance vector, which is calculated based on the number of landmarks, is added to each update packet. As a result of this process, the routing

tables entries with smaller sequence numbers are replaced with larger ones[6].

The Landmark Ad-hoc Routing Protocol (LANMAR) [1, 2, 9, 10, 11] is designed to dramatically reduce the number of routing entries needed and routing update overhead in large-scale ad-hoc networks that exhibit group mobility. Theoretical analysis and simulations [2] have been conducted and the protocol design has been evaluated in a variety of simulated scenarios. Simulation results illustrated that for a scenario with 400 nodes, LANMAR achieved 90% packet delivery ratio while a traditional Link State protocol only delivered 50%. However, without implementation and experimentation in real environments, we really do not fully understand how well LANMAR will perform and how it compares to other ad-hoc routing protocols in practice. In this paper, we describe our implementation of LANMAR in the Linux operation system and investigate the performance of the protocol in a real ad-hoc network to further validate the simulation results from previous studies and to improve upon the current protocol.

2.2.2 DSR

The Dynamic Source Routing protocol (DSR) is a simple and efficient routing protocol designed specifically for use in multihop wireless ad hoc networks of mobile nodes. DSR allows the network to be completely self-organizing and self-configuring, without the need for any existing network infrastructure or administration. All aspects of the protocol operate entirely on demand, allowing the routing packet overhead of DSR to scale automatically to only that needed to react to changes in the routes currently in use. The DSR protocol allows nodes to dynamically discover a source route across multiple network hops to any destination in the ad hoc network. Each data packet sent then carries in its header the complete, ordered list of nodes through which the packet must pass, allowing packet routing to be trivially loop-free and avoiding the need for up-to-date routing information in the intermediate nodes through which the packet is forwarded. By including this source route in the header of each data packet, other nodes forwarding or overhearing any of these packets may also easily cache this routing information for future use. The DSR protocol is composed of two mechanisms that work together to allow the discovery and maintenance of source routes in the ad hoc network:

3. BATTERY MODELS

The zinc/potassium hydroxide/manganese dioxide cells, commonly called alkaline [12] or alkaline manganese dioxide cells, have a higher energy output than zinc-carbon (Leclanche) cells. Other significant advantages are longer shelf life, better leakage resistance, and superior low temperature performance. In comparison to the zinc-carbon cell, the alkaline cell delivers up to ten times the ampere-hour capacity at high and continuous drain conditions, with its performance at low temperatures also being superior to other conventional aqueous electrolyte primary cells. Its more effective, secure seal provides excellent resistance to leakage and corrosion. The use of an alkaline electrolyte,

electrolytic ally prepared manganese dioxide, and a more reactive zinc powder contributes to a higher initial cost than zinc carbon cells. However, due to the longer service life, the alkaline cell is actually more cost-effective based upon cost-per-hour usage, particularly with high drains and continuous discharge. The high-grade, energy-rich materials composing the anode and cathode, in conjunction with the more conductive alkaline electrolyte, produce more energy than could be stored in standard zinc carbon cell sizes. In comparison to the zinc-carbon cell, the alkaline cell [13] delivers up to ten times the ampere-hour capacity at high and continuous drain conditions, with its performance at low temperatures also being superior to other conventional aqueous electrolyte primary cells. Its more effective, secure seal provides excellent resistance to leakage and corrosion. The product information and test data included in this section represent Duracell's newest alkaline battery products. The usage of alkaline electrolyte, electrolytically developed manganese dioxide, and greater reactive zinc powder distributed to a higher initial price than zinc-carbon cells. However, the alkaline cell is really more cost-effective depends upon cost-per-hour (CPH) usage, especially with high drains and uninterrupted discharge and referable to the longer service life. The high- rate, energy-rich substantial composing the cathode and anode, in conjunction with the more conductive alkaline electrolyte, yield more energy than could be storage in zinc carbon cell sizes. The comparability between the zinc-carbon cell and alkaline cell delivers more than ten times the ampere-hour capacity at high and uninterrupted drain precondition, and its performance at low temperatures as well being super ordinate to other formal aqueous electrolyte primary cells. Its more efficient, secure seal allow excellent resistance to corrosion and leakage. The product test data and information are including in this division symbolizes Duracell's most newfangled alkaline battery products.

3.1 DURACELL AA (MX 1500)

Nominal Voltage	1.5 V
Operating Voltage	1.6 - 0.75V
Impedance:	81 m-ohm @ 1kHz
Typical Weight:	24 gm (0.8 oz.)
Typical Volume:	8.4 cm ³ (0.5 in.3)
Storage Temperature Range	-20°C to 35°C
Operating Temperature Range	-20oC to 54oC
Terminals:	Flat
ANSI	15A
IEC	LR6

3.2 PANASONIC AA

Nominal Voltage	1.5V
Operating Voltage	1.6 - 0.75V
Impedance:	136 m-ohm @ 1kHz
Typical Weight:	11.0 grams (0.38 oz.)
Typical Volume:	3.8cm ³ (0.2 in.3)
Storage Temperature Range	-20°C to 35°C
Operating Temperature Range	-20°C to 54°C (-4°F to 130°F)
Terminals:	Cap and base
ANSI	24A
IEC	LR03

3.3. PANASONIC AAA

Nominal Voltage	1.5 V
Operating Voltage	1.6 - 0.75V
Impedance:	136 m-ohm @ 1kHz
Typical Weight:	0.80gm (23.0oz.)
Typical Volume:	3.8 cm ³ (0.2 in.3)
Storage Temperature Range	-20°C to 35°C
Operating Temperature Range	-20oC to 54oC
Terminals:	Flat
ANSI	24A
IEC	LR03

3.4. Duracell MN 2400

Nominal Voltage	1.5V
Operating Voltage	1.6 - 0.75V
Impedance:	250 m-ohm @1kHz
Typical Weight:	11.0 grams (0.39 oz.)
Typical Volume:	3.5cm ³ (0.21 in.3)
Storage Temperature Range	-20°C to 35°C
Operating Temperature Range	-20°C to 54°C (-4°F to 130°F)
Terminals:	Flat
ANSI	24A
IEC	LR03

3.5. DURACELL MX2400

Nominal Voltage	1.5V
Operating Voltage	1.6 - 0.75V
Impedance:	114 m-ohm @ 1kHz
Typical Weight:	11 gm (0.4 oz.)
Typical Volume:	3.5 cm 3 (0.2 in.3)
Storage Temperature Range	-20°C to 35°C
Operating Temperature Range	-20°C to 54°C
Terminals:	Flat
ANSI	24A
IEC	LR03

4. Simulation environments:

The adopted methodology for the results of this work (specifically comparative routing analyses) is based on simulations near to the real time packages before any actual implementation. This is accomplished by simulating the scenario with the help of simulation tool Qualnet [6]. Qualnet is a comprehensive suite of tools for modeling large wired and wireless networks. It uses simulation and emulation to predict the behavior and performance of networks to improve their design, operation and management. Qualnet enables users to design new protocol models, Optimize new and existing models, Design large wired and wireless networks using pre-configured or userdesigned models, Analyze the performance of networks and perform what-if analysis to optimize them. Qualnet is the preferable simulator for ease of operation. So, we found Qualnet be the best choice to implement our scenarios as we do not need every feature possible.

To evaluate and compare the effectiveness of these routing protocols in a Mobile Ad-Hoc network, we performed extensive simulations in QualNet5.0.2 each simulation is carried out under a constant mobility. The simulation parameters are listed in Table

Table.1. Simulation Parameters

S.No	Parameter	Value
1	Antenna model	Omnidirectional
2	Terrain Size	1500X1500
3	No of nodes	60
4	Radio Type	802.11b radio
5	Battery Charge Monitoring Interval	30min
6	Data Rate	2mbps

7	Mobility Model	Random way point
8	Pause Time	10sec
9	Speed of vehicle	min-2m/s, max-10m/s
10	Position granularity	1500
11	Battery model	Residual life Estimator

DESIGNING OF SCENARIO

The Qualnet Simulator is used, has a scalable network library and gives accurate and efficient execution [18].The scenario is designed in such a way that it undertakes the real traffic conditions. We have chosen 60 fast moving vehicles in the region of 1500X1500 m2 with the random way point mobility model. There is also well defined path for some of the vehicles. It shows wireless node connectivity of few vehicles using CBR application. The area for simulation is Hilly area with altitude of 1500 meters. Battery model are DURACELL AA (MX 1500), PANASONIC AA, PANASONIC AAA, Duracell MN 2400, DURACELL MX2400.The simulation is performed with different node mobility speed and CBR (Constant bit rate) traffic flow. CBR traffic flows with 512 bytes are applied. Simulations is made in different speed utilization with IEEE 802.11 Medium access control (MAC),the data rate 2mbps. The network protocol here applied is Internet Protocol version four (IPv4). By this proposed topology the failure of node can be easily detected and it gives the way for the accuracy in their performance.

PERFORMANCE METRICS

4.1 Throughput

It is one of the dimensional parameters of the network which gives the fraction of the channel capacity used for useful transmission selects a destination at the beginning of the simulation i.e., information whether or not data packets correctly delivered to the destinations.

4.2 Average End to End delay

The average end-to-end delay of data packets is the interval between the data packet generation time and the time when the last bit arrives at the destination [6].

4.3 Packet Delivery Sent

It is the ratio of the number of data packets received by the CBR sink at the final destinations to the number of data packets originated by the “application layer” at the CBR sources.

4.4 Average Jitter

Average Jitter is the variation (difference) of the inter-arrival times between the two successive packets received.

4.5 Throughput (bit/s)

Throughput is the average rate of successful message delivery over a communication channel. The throughput is measured in bits per second (bit/s or bps), and rarely in packets per second or packets per time slot

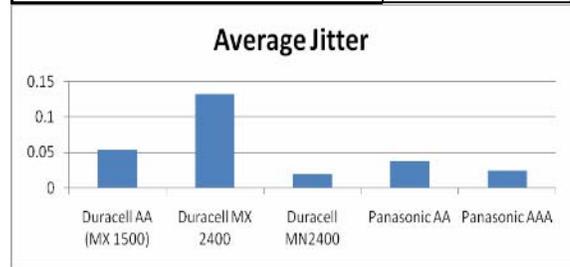
RESULTS

Average jitter: For any protocol less average jitter gives better performance. As per the results given table made by the observations on Qualnet 5.0, it is clear that the average jitter is less for Panasonic AAA battery as compared to the other battery models (Duracell AA (MX1500), Duracell (MX 2400), Duracell AA (MN2400)) for Dynamic Source Routing Protocol as well as LANMAR.

DSR

Average Jitter

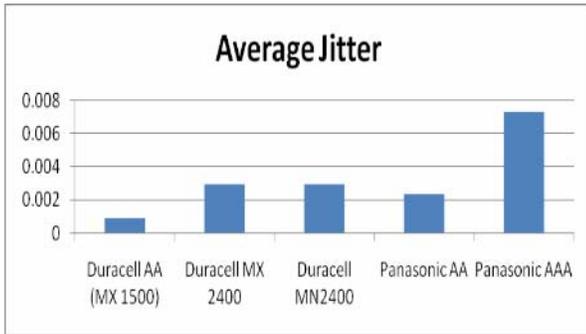
Battery Model	Value
Duracell AA (MX 1500)	0.054268
Duracell MX 2400	0.131913
Duracell MN2400	0.018204
Panasonic AA	0.0375267
Panasonic AAA	0.0235965



Lanmar

Average Jitter

Battery Model	Value
Duracell AA (MX 1500)	0.000871164
Duracell MX 2400	0.00293578
Duracell MN2400	0.00293578
Panasonic AA	0.00230374
Panasonic AAA	0.00732541

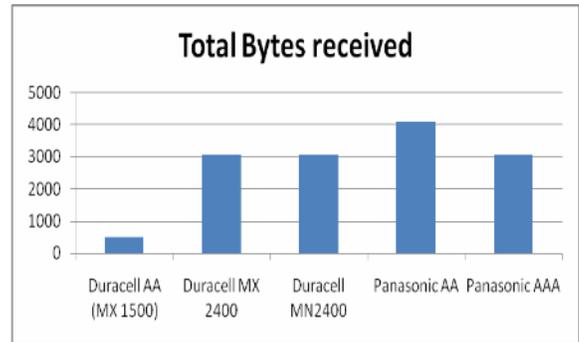


LANMAR

Total Bytes received

Battery Model	Value
Duracell AA (MX 1500)	512
Duracell MX 2400	3072
Duracell MN2400	3072
Panasonic AA	4096
Panasonic AAA	3072

Total Bytes received: The total bytes received for Dynamic Source Routing is maximum for the three battery models that are Duracell MN 2400, Panasonic AA and Panasonic AAA while for LANMAR protocol total bytes received is maximum for Panasonic AA & is same for Panasonic AAA, Duracell MN 2400 & Duracell MX2400.



DSR

Total Bytes received

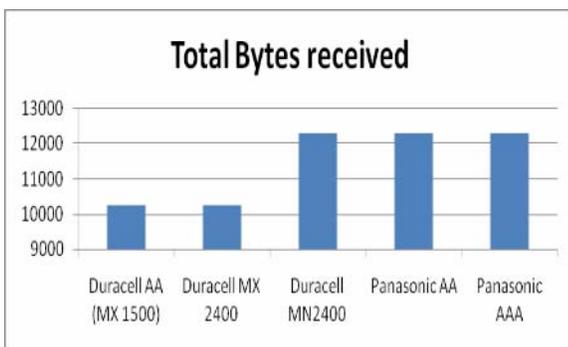
Battery Model	Value
Duracell AA (MX 1500)	10240
Duracell MX 2400	10240
Duracell MN2400	12288
Panasonic AA	12288
Panasonic AAA	12288

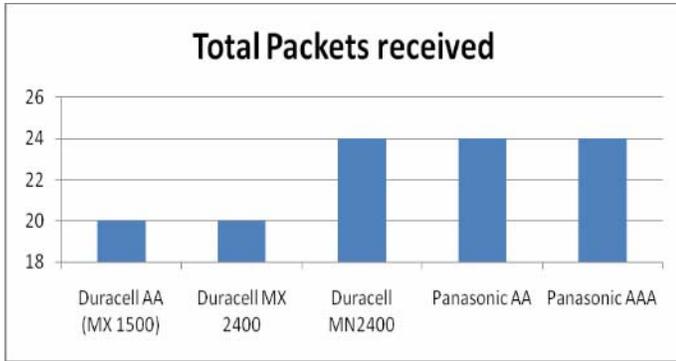
Total Packets received: For Dynamic Source Routing Protocol all the 24 packets are received in Duracell MN 2400, Panasonic AA & Panasonic AAA while for LANMAR Protocol total packets received are maximum for Panasonic AAA but the quantity is 10 i.e. only 42% of the total packets.

DSR

Total Packets received

Battery Model	Value
Duracell AA (MX 1500)	20
Duracell MX 2400	20
Duracell MN2400	24
Panasonic AA	24
Panasonic AAA	24





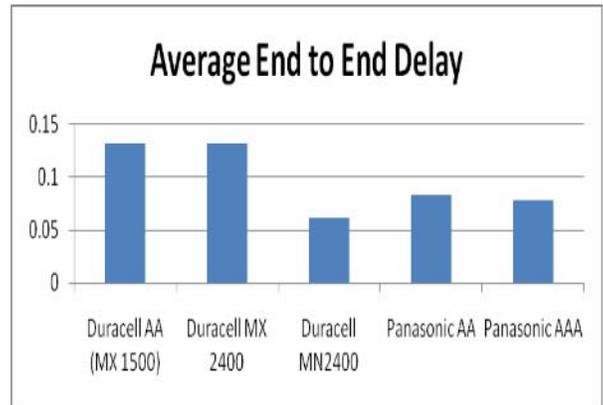
LANMAR

Total Packets received

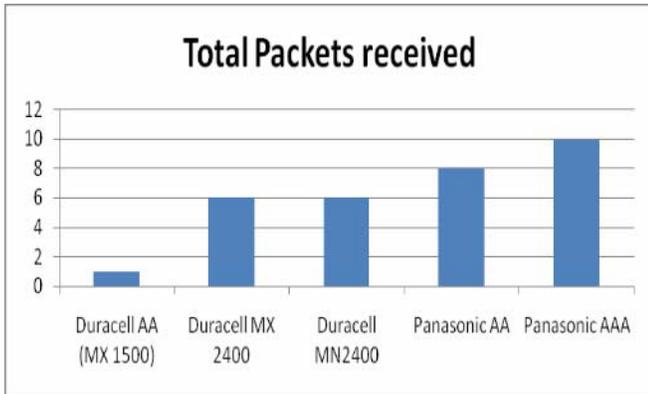
Battery Model	Value
Duracell AA (MX 1500)	1
Duracell MX 2400	6
Duracell MN2400	6
Panasonic AA	8
Panasonic AAA	10

DSR

Battery Model	Value
Duracell AA (MX 1500)	0.131913
Duracell MX 2400	0.131913
Duracell MN2400	0.0618118
Panasonic AA	0.0834311
Panasonic AAA	0.0776924

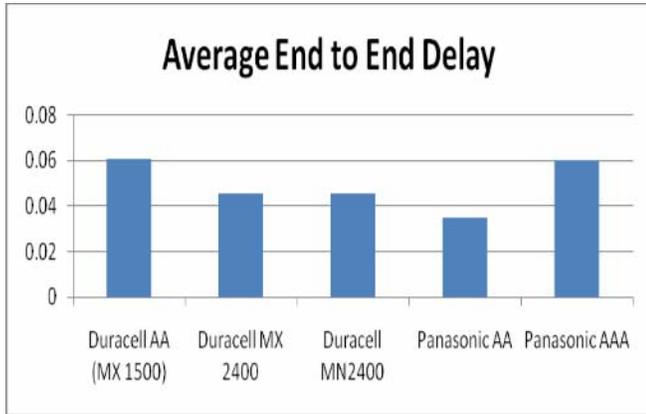


LANMAR



Battery Model	Value
Duracell AA (MX 1500)	0.0606365
Duracell MX 2400	0.0458097
Duracell MN2400	0.0458097
Panasonic AA	0.0346983
Panasonic AAA	0.0602067

Average End to End Delay: The delay should be always minimum & in case of Dynamic Source Routing Protocol it is minimum in Duracell MN2400 Battery Model as compared to all other battery models while for LANMAR Protocol it is minimum for Panasonic AA as compared to all other battery models.

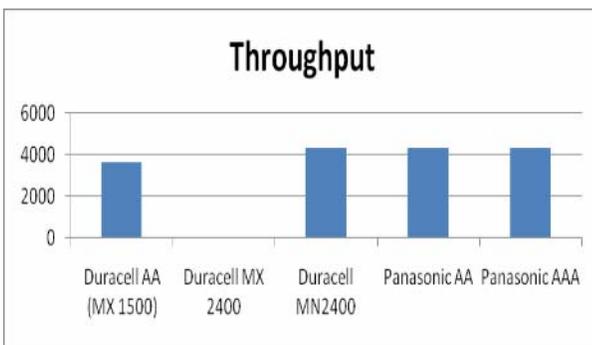


Throughput: Higher the throughput is better the performance is. Here for Dynamic Source Routing protocol throughput is maximum for Panasonic AA battery model as compared to all other battery models while for LANMAR protocol it is maximum for both Duracell MN2400 & Duracell MX2400.

DSR

Throughput

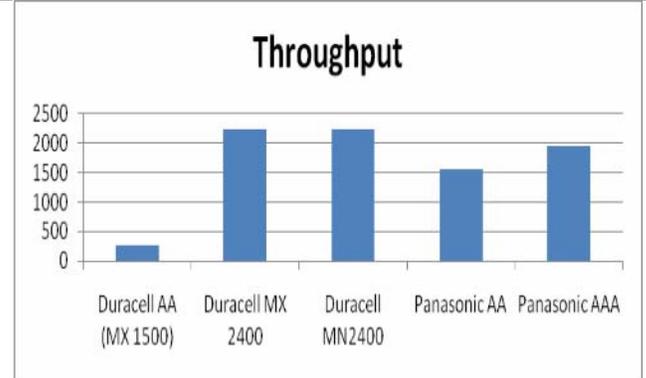
Battery Model	Value
Duracell AA (MX 1500)	3647
Duracell MX 2400	0
Duracell MN2400	4352
Panasonic AA	4366
Panasonic AAA	4361



LANMAR

Throughput

Battery Model	Value
Duracell AA (MX 1500)	274
Duracell MX 2400	2246
Duracell MN2400	2246
Panasonic AA	1562
Panasonic AAA	1956



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