Evaluation of Proactive, Reactive and Hybrid Ad hoc Routing Protocol for various Battery models in VANET using Qualnet

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Abstract - In VANET high speed is the real characteristics which leads frequent breakdown, interference etc. In this paper we studied various Ad hoc routing protocols, Reactive, Proactive & Hybrid, taking in to consideration various VANET parameters like speed, altitude etc in real traffic scenario and evaluated them for various battery models for energy conservation. The AODV and DYMO (Reactive), OLSR (Proactive) and ZRP (hybrid) protocols are compared for battery models Duracell AA(MX-1500),Duracell AAA(MN-2400),Duracell AAA(MX-2400), Duracell C-MN(MN-1400),Panasonic AA standard using Qualnet as a Simulation tool. Since Energy conservation is main focus area now days. Hence performance of the protocols with various battery models counts and helps to make a right selection. Varying parameters of VANET shows that in the real traffic scenarios proactive protocol performs more efficiently for energy conservation.

Keywords - VANET, Ad hoc Routing, battery models, Qualnet.

I. INTRODUCTION

Vehicular Ad hoc Network (VANET) is a new communication paradigm that enables the communication between vehicles moving at high speeds. It has been found that mobile terminals in fast moving vehicles like cars, buses, trains are frequent signal breakdowns as compared to pedestrians. It has been found that in the last decade so many functions like gaming, internet etc. has been added leading to fast CPU clock speed hence more battery consumption. In order to improve QoS and energy conservation in fast moving vehicles various light weight routing protocols needed to be studied in Physical and data link layer. So that Right selection of the protocol can be made. There are mainly three types of routing protocols, Reactive [1], Proactive [2], Hybrid [3]. These protocols are having different criteria for designing and classifying routing protocols for wireless ad hoc network. The Mobile Ad hoc Network (MANET) working group of the Internet Engineering Task Force (IETF) [4] develops standards for routing in dynamic networks of both mobile and static nodes. The protocols in focus now days are Hybrid protocols and others [7]. Its use in the context of VANET’s along with reactive and proactive has always been area under investigation. Routing protocols are always challenging in the fast moving nodes as their performance degrades and such type of network is difficult to manage as fast handoff, signal quality, Interference maximizes along with other geographical factors.

In this work, the feasibility, the performance, and the limits of ad hoc communication using the three types of protocols is evaluated as per battery models Duracell AA(MX-1500),Duracell AAA(MN-2400),Duracell AAA(MX- 2400),Duracell C-MN(MN-1400),Panasonic AA standard using Qualnet as a Simulation tool. A micro simulation environment for road traffic supplied vehicle movement information, which was then fed in to an event-driven network simulation that configured and managed a VANET model based on this mobility data. The protocols and their various parameters of the transport, network, data link, and physical layers were provided by well-tested implementations for the networks simulation tool, while VANET mobility is performed by our own implementation.

II. AD HOC ROUTING PROTOCOLS

Routing protocol is a standard that controls how nodes decide how to route the incoming packets
between devices in a wireless domain & further
Distinguished in many types. There are mainly three
types of routing protocols. Ad-hoc on demand vector
distance vector (AODV), Dynamic MANET On demand
(DYMO) and Dynamic source routing (DSR) are the
elements of reactive routing protocols whereas
Optimized Link State Routing (OLSR) and Fishey state
routing (FSR) are the examples of proactive routing
protocols. Hybrid routing protocols is the combination
of both proactive and reactive routing protocols,
Temporary Ordered Routing Algorithm (TORA), Zone
Routing Protocol (ZRP), Hazy Sighted Link State
(HSLS) and Orderon Routing Protocol (OOPR) are its
examples. In our work the chosen protocols are AODV,
DYMO, OLSR and ZRP.

A. Ad-hoc on demand vector distance vector (AODV)

AODV [7] shares DSR’s on-demand characteristics
in that it also discovers routes on an as needed basis via
a similar route discovery process. However, AODV
adopts a very different mechanism to maintain routing
information. It uses traditional routing tables, one entry
der each destination. This is in contrast to DSR, which can
maintain multiple route cache entries for each
destination. Without source routing, AODV relies on
routing table entries to propagate an RREP back to the
source and, subsequently, to route data packets to the
destination. AODV uses sequence numbers
maintained at each destination to determine freshness of
routing information and to prevent routing loops. All
routing packets carry these sequence numbers.

B. Dynamic MANET On demand (DYMO)

DYMO[9] is another reactive routing protocol that
works in multi hop wireless networks. It is currently
being developed in the scope of IETF’s [4] MANET
working group and is expected to reach RFC status in
the near future. DYMO is considered as a successor to
the AODV routing protocols. DYMO has a simple
design and is easy to implement. The basic operations of
DYMO protocol are route discovery and route
Maintenance was studied extensively [8] along with
comparison of two on demand routing protocols.

C. Optimized Link State Routing (OLSR)

OLSR [10] is the proactive routing protocol that is
evaluated in this synopsis. Basically OLSR is an
optimization of the classical link state algorithm adapted
for the use in wireless ad hoc networks. In OLSR, three
levels of optimization are achieved. First, few nodes are
selected as Multipoint Relays (MPRs) to broadcast the
messages during the flooding process. This is in contrast
to what is done in classical flooding mechanism, where
every node broadcasts the messages and generates too
much overhead traffic.

D. Zone Routing Protocol (ZRP)

Hybrid routing combines characteristics of both
reactive and proactive routing protocols to make routing
more scalable and efficient [11]. Mostly hybrid routing
protocols are zone based; it means the number of nodes
is divided into different zones to make route discovery
and maintenance more reliable for MANET. The need
of these protocols arises with the deficiencies of
proactive and reactive routing and there is demand of
such protocol that can resolve on demand route
discovery with a limited number of route searches. ZRP
limits the range of proactive routing methods to
neighbouring nodes locally; however ZRP uses reactive
routing to search the desired nodes by querying the
selective network nodes globally instead of sending the
query to all the nodes in network. ZRP uses “Intrazone”
and “Interzone” routing to provide flexible route
discovery and route maintenance in the multiple ad hoc
environments. Interzone routing performs route
discovery through reactive routing protocol globally
while intrazone routing based on proactive routing in
order to maintain up-to-date route information locally
within its own routing range. The overall characteristic
of ZRP is that it reduces the network overhead that is
caused by proactive routing and it also handles the
network delay that is caused by reactive routing
protocols and perform route discovery more efficiently.
Normal routing protocols which works well in fixed
networks does not show same performance in mobile ad
hoc networks. In these networks routing protocols
should be more dynamic so that they quickly respond to
topological changes. There is a lot of work done on
evaluating performance of various MANET routing
protocols for constant bit rate traffic

III. 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.

A. 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 cm³ (0.5 in.³) |
| Storage Temperature Range: | -20°C to 35°C |
| Operating Temperature Range: | -20°C to 54°C |
| Terminals: | Flat |
| ANSI: | 15A |
| IEC: | LR6 |

B. Duracell AAA (MX-2400)

| Nominal Voltage: | 1.5 V |
|-----------------|-------|
| Operating Voltage: | 1.6 - 0.75V |
| Impedance: | 114 m-ohm @ 1kHz |
| Typical Weight: | 11 gm (0.4 oz.) |
| Typical Volume: | 3.5 cm³ (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 |

C. Duracell AAA (MN-2400)

| Nominal Voltage: | 1.5 V |
|-----------------|-------|
| Operating Voltage: | 1.6 - 0.75V |
| Impedance: | 250 m-ohm @ 1kHz |

D. Duracell C-MN (MN-1400)

| Nominal Voltage: | 1.5 V |
|-----------------|-------|
| Operating Voltage: | 1.6 - 0.75V |
| Impedance: | 136 m-ohm @ 1kHz |
| Typical Weight: | 139 gm (4.9 oz.) |
| Typical Volume: | 3.8 cm³ (0.2 in.³) |
| Storage Temperature Range: | -20°C to 35°C |
| Operating Temperature Range: | -20°C to 54°C |
| Terminals: | Flat |
| ANSI: | 13A |
| IEC: | LR20 |

E. Panasonic AA

| 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 cm³ (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 |

IV. SIMULATION TOOL

The collaboration of imminent research objectives and its related scope in this study are also collapsed into same influence of simulation environment for generating some authenticated outcomes. For this purpose, the adopted methodology for the results of this research work (specifically comparative routing analyses) is based on simulations near to the real time packages before any actual implementation.
QualNet is a comprehensive suite of tools for modelling large wired and wireless networks. It uses simulation and emulation to predict the behaviour 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 user-designed models, Analyze the performance of networks and perform what-if analysis to optimize them. QualNet (6) 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, just those for the token passing and message routing. QualNet is a commercial simulator that grew out of GloMoSim, which was developed at the University of California, Los Angeles, UCLA, and is distributed by Scalable Network Technologies [6]. The QualNet simulator is C++ based. All protocols are implemented in a series of C++ files and are called by the simulation kernel. QualNet comes with a java based graphical user interface (GUI).

Table 1. Simulation Parameters

| Simulator   | Qualnet Version 5.0.1 |
|-------------|-----------------------|
| Terrain Size| 1500 x 1500            |
| Simulation time | 3000s                   |
| No. Of Nodes   | 15                     |
| Mobility      | Random Way Point       |
| Pause time    | 0s                     |
| Speed of Vehicles | Min.=3m/s Max.=20m/s  |
| Routing Protocols | AODV, DYMO, OLSR, ZRP |
| Medium Access protocol | 802.11 MAC, 802.11 DCF |
| Tx Power      | 150 dbm                |
| Data size     | 512 bytes              |
| Data Interval | 250ms                  |
| No. of sessions | 5                     |
| Altitude      | 1500                   |
| Weather mobility | 100ms                 |
| Battery models | Duracell AA(MX-1500), Duracell AAA(MN-2400), Duracell AAA(MX-2400), Duracell C-MN(MN-1400), Panasonic AA |

VI. DESIGNING OF SCENARIO

The scenario is designed in such a way that it undertakes the real traffic conditions. We have chosen 15 fast moving vehicles in the region of 1500X1500 with the random way point mobility model. There is also well defined path for some of the vehicles, so that real traffic conditions can also be taken care of. It also shows wireless node connectivity of few vehicles using CBR application. The area for simulation is Hilly area with altitude of 1500 meters. Weather mobility intervals is 100ms. Pathloss model is two ray with max prop distance of 100m.

![Fig. 1 : Qualnet VANET Scenario](image1)

VI. RESULTS AND DISCUSSION

The simulation result brings out some important characteristic differences between the routing protocols. In all the simulation results OLSR outperforms the other protocols. This is because OLSR is a proactive protocol and it pre determines the route in well defined manner. It uses destination sequence numbers to ensure loop freedom at all times and it offers quick convergence when the network topolology changes. The residual battery capacity of OLSR for all the Duracell models are maximum and same whereas for Panasonic model is low as compare for AODV.

![Fig. 2 : Battery model comparison for AODV](image2)
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