Routing for Urban and Rural Areas in VANET Environment

Urmila Prajapati[1] Girish Kaushal[2] Piyush Chouhan[3]
[1,2,3]Department of Computer Engineering
[1]MIT, UJJAIN [2,3]Shri Vaishnav Polytechnic, Indore

Abstract— *VANET is different from MANET due to high mobility of nodes and the large scale of networks. Security and traffic are the two main concerns in designing a VANET .Although there are many proposed solutions for improving securities in VANET but security still remains a delicate research subject. In this paper Creation of Rural area network and urban area network in VANET Scenario for NS-2 and then to create Different routing protocols with the use of various performance matrices Like Residual Energy and Throughput with two routing protocols which are AODV and DSR.*

Keywords— VANET, AODV, DSR and IEEE80211p

I. Introduction

VANET presents a new and promising field of research, development and standardization. Throughout the world, there are many national and international projects in governments, industry, and academia devoted to the development of VANET protocols (Appendix B). These projects include consortiums like 'The Dedicated Short Range Communications (DSRC)' (USA), the 'Car-to-Car Communication' (Europe) and the 'Intelligent Transportation Systems' (Japan), and standardization efforts like the IEEE 802.11p 'Wireless Access in Vehicular Environment' (WAVE) [1]. IEEE 802.11p is for short range communication with up to a few hundred meters. With this limitation, we need to have several APs/Road Side Units (RSUs) to cover the road or to manage the existing RSU work in such a way that their interactions with the vehicles in the range are properly polled.

A. *Rural Network:*

A number of technologies, such as satellites, vehicular networks can be utilized for linking rural areas. However, 802.11 based mesh networks stand out as the cheapest, both to deploy as well as to use, and the easiest to implement. In addition, the spectrum used by the 802.11 protocol is unlicensed in most of the world, so cumbersome and expensive bureaucratic processes of obtaining the license can be avoided. Several university research groups are experimenting with deploying wireless networks in rural areas of Africa and Asia. These attempts usually aim to connect those who have information and those who need it. Therefore, long distances that prevent the poor rural population from reaching medical governmental and other professional services are being bridged by carefully designed wireless links. In a typical deployment the links span from a nearby city to a so called kiosk located in a remote village.

B. *Urban Network:*

VANET deployment in an urban setting in which a wireless multi-hop network of stationary mesh nodes enable or supplements the network connectivity among mobile nodes. Mesh nodes can be strategically positioned at a subset of street intersections. We evaluated two deployment scenarios: (1) mesh-enhanced peer-to-peer routing (MEPPR) where both the mobile nodes and static mesh nodes participate in routing, and (2) mesh-enhanced infrastructural routing (MEIR) where only the static mesh nodes participate in routing and forwarding packets generated by mobile nodes [9].

II. VANET Characteristics

VANETs, Wireless Sensor Networks and Wireless Mesh Networks are special cases of the general MANETs, VANETs possess some distinguishable characteristics that make its nature a unique one. These properties present considerable challenges and require a set of new especially designed protocols.

- Due to the high mobility of vehicles, that can be up to one hundred fifty kilometers per hour, the topology of any VANET changes frequently and unexpectedly. Hence, the time that a communication link exists between two vehicles is very short especially when the vehicles are traveling in opposite directions. A one solution to increase the lifetime of links is to increase the transmission power, but increasing a vehicle's transmission range will increase the collision probability and degrade the overall throughput of the system. The other solution is to have a set of new protocols employing a very low latency.
- Yet another effect of the high mobility of nodes is that the usefulness of the broadcasted messages is very critical to latency. Assuming for example that a vehicle is suddenly stopping, it should send a broadcast message to warn other vehicles of the probable danger. Considering that the driver needs at least 0.70 to 0.75 sec to initiate his response [14], the warning message should be delivered at virtually zero sec latency.
- In VANETs, location of nodes changes very quickly and unpredictably, so that, building an efficient routing table or a list of neighbor nodes will exhaust the wireless channel and decrease the network efficiency. Protocols that rely on prior information about location of nodes are likely to have a poor performance.
- Nevertheless, the topology of a VANET can be a benefit because vehicles are not expected to leave the paved road hence the running direction of vehicles is predictable to some extent.
- Although, the design challenge of protocols in wireless sensor networks is to minimize the power consumption, this is not a problem in VANETs. Nodes in VANETs depend on a good power supply (e.g. vehicle battery and the dynamo) and the required transmission power is small compared with power consumption of on-board facilities (e.g. air-condition).
- It is expected that, as VANET is initially deployed, only a small percentage of vehicles will be equipped with transceivers. Thus, the benefits of the new technology, especially OBU-to-OBU applications, will

not rise until many years. Moreover, the limited number of vehicles with transceivers will lead to a frequent fragmentation of the network. Even when VANET is fully deployed, fragmentation may still exist in rural areas, thereupon, any VANET protocol should expect a fragmented network.

- Privacy and security are of crucial effect on the public acceptance of this technology. In VANETs, every node represents a specific person and its location tells about his location. Any lack of privacy can ease a third party monitoring person's daily activities. However, from the other point of view, higher authorities should gain access to identity information to ensure punishment of illegal actions, where, there is a fear of a possible misuse of this feature. The tampering with messages could increase false alarms and accidents in some situations defeating the whole purpose of this technology.

Finally, the key difference between VANET protocols and any other form of Ad-Hoc networks is the design requirement. In VANETs, the key design requirement is to minimize latency with no prior topology information. However, the key design requirement of Wireless Sensor Network is to maintain network connectivity with the minimum power consumption and the key design requirement of Wireless Mesh Network is reliability.

Concluding, the main characteristics of VANETs can be summarized as follows [9];

- High mobility of nodes
- No prior information about the exact location of neighbor nodes
- Predictable topology (to some extent)
- Critical latency requirement especially in cases of safety related applications
- No problem with power
- Slow migration rate
- High possibility to be fragmented
- Crucial effect of security and privacy

III. VANET ROUTING

In the latest years, research has been conducted on improving the performance of the MANET routing protocols. To deal with the complexity of the routing protocols, MANET has become a vital issue for The Internet Engineering Task Force (IETF) and therefore a MANET working group (WG) is established by IETF. The role of this group is to be involved in the development of two routing protocols such as AODV and DSDV and so on.

A. Ad Hoc on Demand Distance Vector Routing (AODV):

AODV utilizes destination sequence numbers to ensure all routes are loop-free and contain the most recent route information. Each node maintains its own sequence number, as well as a broadcast ID. The broadcast ID is incremented for every RREQ the node initiates, and together with the node's IP address, uniquely identifies an RREQ. Along with its own sequence number and the broadcast ID, the source node includes in the RREQ the most recent sequence number it has for the destination. Intermediate nodes can reply to the RREQ only if they have a route to the destination whose corresponding destination sequence number is greater than or equal to that contained in the RREQ. During the process of forwarding the RREQ, intermediate nodes record in their route tables the address of the neighbor from which the first copy of the broadcast packet is received, thereby establishing a reverse path. If additional copies of the same RREQ are later received, these packets are discarded. Once the RREQ reaches the destination or an intermediate node with a fresh enough route, the destination or an intermediate node responds by unicasting a route reply (RREP) packet back to the neighbor from which it first received the RREQ (Figure). As the RREP is routed back along the reverse path, nodes along this path set up forward route entries in their route tables which point to the node from which the RREP came. These forward route entries indicate the active forward route.

B. Dynamic Source Routing (DSR):

In VANETs, the DSR protocol generates two mechanisms namely route discovery and route maintenance for the purpose of discovering and maintaining the route between the endpoints. Both mechanisms are utilized to support the unidirectional (asymmetric routes) links in wireless ad-hoc network.

C. Route Discovery:

Figure shows that to commence the Route Discovery mechanism, node M floods a Route Request to all nodes which are in the wireless transmission range of M. In the network, the initiator (source node) and target (destination node) of the Route Discovery is identified by each Route Request packet. The source node also provides a unique request identification number in its Route Request packet and in Figure this is given as ID= 3.

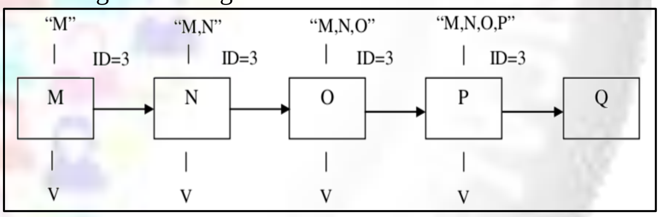

Fig. 1: Route discovery mechanism for DSR

For responding to the Route Request, the target node Q generally scans its own Route Cache for a route before sending the Route Reply toward the initiator node M. However, if no suitable route is found, node Q will execute its own Route Discovery mechanism in order to reach toward the initiator.

D. Route Maintenance:

The Route Maintenance mechanism is used when the source node is unable to use its current route to the destination due to changes in the network topology. In such case, the source has to use any other route to the destination. However, it may invoke the Route Discovery mechanism again to discover a new route. Each node while using a source route has to ensure that data can be transmitted properly from that particular node to the subsequent nodes. Consequently, an acknowledgement is made for confirming that a link is able to transmit the data. In wireless networks, acknowledgements are often provided either as an existing standard part of the MAC protocol in use (such as the linklayer acknowledgement frame defined by IEEE 802.11), or by a "passive acknowledgement" [16]. In addition, a specific software acknowledgement can also be implemented by the DSR itself in case of no built-in acknowledgement present in the system.

IV. NETWORK SCENARIOS

We have implemented our work i.e. Creation of Rural area and Urban area in VANET Scenario for NS-2 and then to create Different routing protocols with the use of various performance matrices Like Residual energy and Throughput. In our case firstly we have created scenario file for IEEE 802.11p standard which has to be used along with our TCL Script than we have created a TCL script consist of various routing protocols in our case these are AODV and DSR than a particular VANET scenario or topology in our case it consist of Rural and Urban area with static and dynamic nodes with 50sec simulation time.

In this section, two scenarios are described with two different protocols which are AODV and DSR presented in tabular form.

Simulation Tool	NS-2.35
IEEE Scenario	802.11p
Propagation	Two Ray Ground
Network area	Rural area, Urban area
Traffic Type	TCP
Antenna	Omni directional antenna
MAC Type	IEEE 802.11p
Routing Protocol	AODV, DSR
Queue limit	50 Packets
Simulation area (in metre)	2000*2000
Queue type	Droptail, cmupriqueue
Channel	Wireless Channel
Simulation time	50 sec.

Table 1: Different protocols AODV and DSR

V. EVALUATION OF RESULTS

A. *Throughput:*

The average rate at which the data packet is delivered successfully from one node to another over a communication network is known as throughput. The throughput is usually measured in bits per second (bits/sec). A throughput with a higher value is more often an absolute choice in every network.

Figure shows the Throughput under Rural area network and urban area network with AODV routing protocol.

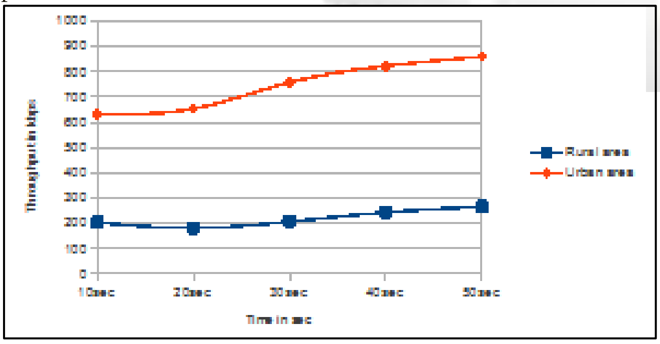

Fig. 2: Throughput for AODV

Figure shows the Throughput under Rural area network and Urban area network with DSR routing protocol.

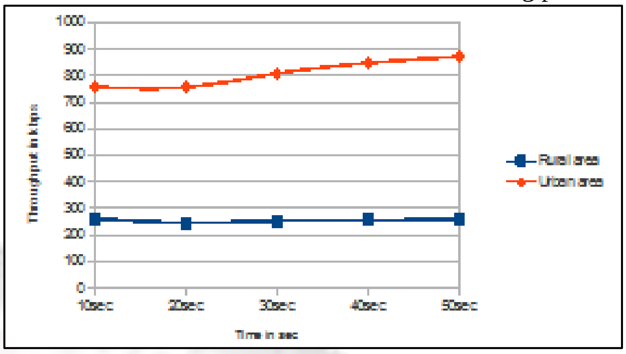

Fig. 3: Throughput for DSR

B. *Residual Energy:*

Total amount of energy used by the Nodes during the Communication or simulation.

Figure shows the Residual Energy under Rural area network and Urban area network with AODV routing protocol.

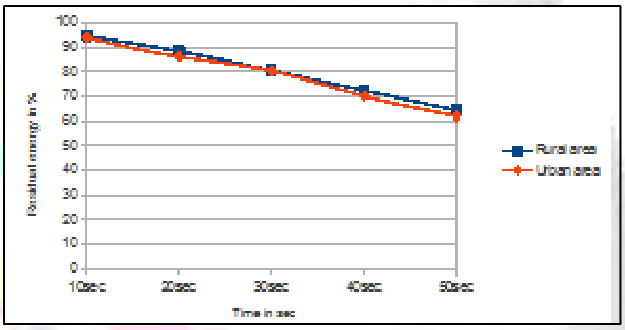

Fig. 4: Residual energy for AODV

Figure shows the Residual Energy under Rural area network and urban area network with DSR routing protocol.

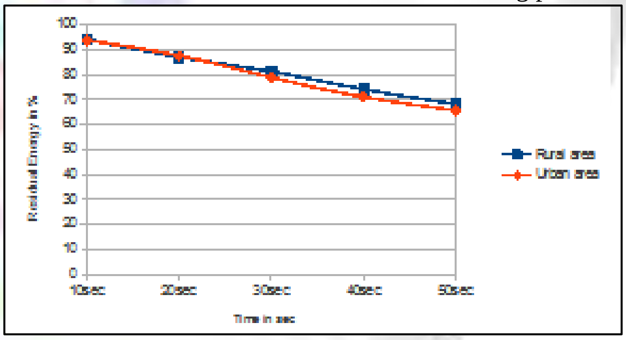

Fig. 5: Residual energy for DSR

VI. CONCLUSION

Work has been done and it is concluded that throughput are high in Urban area as compare to the Rural area network with AODV and DSR routing protocol whereas Residual Energy of Rural area is high as compare to the Urban area for AODV and DSR routing protocol.

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