ANALYSIS AND COMPARISON OF PROACTIVE AND REACTIVE ROUTING PROTOCOLS FOR WANET IN QUALNET

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Abstract: In case of Wireless Ad Hoc Networks (WANETs) topology changes due to freely moving mobile nodes. Conventional Routing protocols need modifications so as to accommodate change in configuration to maintain performance matrices.

Paper presents Qualitative and Quantitative analysis of existing routing protocols through comparison of their properties according to different criteria. Simulation study and analysis and relative performance evaluation according to different criteria like node mobility and node density was carried out on Qualnet.

Keywords: Wireless Ad-Hoc Network, Routing Protocols, Proactive Routing Protocol, Reactive Routing Protocol, Qualnet

1. INTRODUCTION

Wireless ad hoc networks are networks without infrastructure, where every node works as a router. In these networks, every node must discover its neighbors it will communicate to nodes that are out of its transmission range (multi-hop routing). The challenge in creating a routing protocol for ad hoc networks is to design a single protocol that can adapt to the wide variety of conditions that can be present in any ad hoc network environment. The routing protocol must perform efficiently in environments in which it suffers from high nodes mobility and many wireless transmission constraints. Since it is often impossible to know in advance what environment the protocol will find itself in, and environment can change unpredictably as well, the routing protocol must be able to adapt automatically. These networks suffer from all kinds of uncertainty, randomness and fuzziness which is due to; high bit error rate (BER) in the wireless channel, increased collisions due to the presence of hidden terminals; signals interference and attenuation; location dependent connection; unidirectional links and frequent link breaks due to nodes mobility. Hence there is a need for high adaptive routing protocols with adapting capabilities to high variability network protocols.

2. ROUTING PROTOCOLS

Routing protocol in the WANETs are responsible for deciding the path between the source node and the destination node, it must be able to choose the best path from the available paths. Routing protocols plays very important role to improve the performance of the Wireless Ad-Hoc Network to improve the performance and the overall throughput of the network. Routing protocols maintains the routing table to update the information about the distance between destination nodes, the previous and the next node along the routes. Nodes in the network exchanges the routing table to update the information about the network topology changes every time due to the mobility of the nodes.

Wireless Ad Hoc Networks (WANETs) are characterized as having a dynamic, multihop, potentially rapid changing topology. Conventional protocols can be classified as reactive, proactive and hybrid. Table 1 describes the characteristics of routing protocols.
Table 1
Comparison between the Proactive and Reactive Routing Protocols

<table>
<thead>
<tr>
<th>Proactive Protocols</th>
<th>Reactive Protocols</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hybrid Protocols</td>
<td></td>
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</tbody>
</table>

Characteristics

- Consistent; up-to-date routing information
- Table-driven; one or more tables to store routing information
- No latency in route discovery
- Continuously evaluate routes
- No latency in route discovery
- Large number of control packets necessary to keep network information current
- A lot of routing information may never be used

- On-demand operation
- Route discovery by global search
- There are delays due to route discovery
- No Control packet for routing table maintenance.
- Most appropriate for environments in which nodes move around a lot
- Route Discovery Process
- Maintenance of a Route
- delays due to route discovery

Classification

Number of necessary routing-related tables

Examples

DSDV, CGSR, WRP, OLSR

AODV, DSR, LMR, TORA, SSR

In the paper OLSR [3, 4] is considered as a representative of a proactive routing protocol for Wireless ad hoc networks, while Dynamic Source Routing (DSR) [5, 6, 7] is used as a representative for a reactive protocol to carry out analysis and comparison of two classes of routing protocols using Qualnet simulator.

3. PERFORMANCE METRIC

To evaluate the performance of routing protocols, both qualitative and quantitative metrics are needed. Routing protocols use several metrics to calculate the best path for routing the packets to its destination. These metrics are a standard measurement that could be number of hops, which is used by the routing algorithm to determine the optimal path for the packet to its destination. Most of the routing protocols ensure the qualitative metrics. Therefore, four different quantitative metrics are used to compare the performance. They are,

- **Packet Delivery Ratio (PDR):** The ratio of the number of data packets received by the receivers verses the number of data packets supposed to be received. This number presents the effectiveness of a protocol.

- **Average End-to-end delay:** End-to-end delay indicates how long it took for a packet to travel from the source to the receiver.

- **Throughput:** The throughput is defined as the total amount of data a receiver actually receives from the sender divided by the time between receiving the fast packet and last packet.

- **Jitter:** Jitter metric, which is used in this paper, is a quantifier of the changeability over time of the packet latency across a network and can be a measurement for the quality of a communication. A zero jitter shows a very high quality communication without any latency.

4. QUALNET SIMULATOR

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 [8]. 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 and analyze the performance of networks and perform what-if analysis to optimize them. The kernel of QualNet is a, SNT-proprietary, parallel discrete-event scheduler which provides the scalability and on a variety of platforms [8].
Network topology is referred to as a scenario which allows the user to specify all the network components and conditions under which the network will operate. Procedure steps are as follows:

- Open the Qualnet using shortcut on desktop.
- Use file menu to open the new file or existing file (*.config).
- Use drag and drop to insert nodes in the working space given for creating network topology.
- Insert at least one wireless subnet which will be helpful for the wireless connection.
- Connect all the nodes to the wireless subnet to establish the wireless connection by selecting link.
- Select property of each link by right click/double click and set link parameter.
- Select the routing protocols to be followed by double click on each node.
- Run the simulation by selection run button.
- On completion of simulation open the result file to observe the results.

5. SIMULATION SETUP AND RESULTS

The simulation results were carried out Qualnet simulator version 5 [8] to evaluate the performance of the two routing protocol [9, 10, 11] DSR & OLSR on the Wireless Ad-Hoc network with the 50 nodes with the parameters selection as follows in the simulator.

The 50 nodes were generated for each protocol within the terrain of 1500m X 1500m and for the node density variation node can be enabled or disabled according to the network topology and the no. of nodes in the network to study the performance of number of node variation in the network. The random waypoint mobility is provided to realization as a real time simulation with the pause time of 30S, min speed of the 5mps and max speed of 20 mps. We have taken the network protocol as IPv4 and MAC protocol of the 802.11. The packet reception model is PHY 802.11b is considered here. The propagation channel frequency is 2.4 GHz, the two ray ground propagation model and omnidirectional antenna is considered. The traffic generated between some random nodes is CBR type. We have carried out the simulation for the simulation time of 300S. We have derived the simulation results based on the above performance metric using the network of 50 nodes and the nodes can be enabled and disabled according to the requirement for the DSR and OLSR proactive type of protocols.
Figure 4: Average End to end Delay V/S Mobility

Figure 7: Average Throughput V/S Node Density

Figure 5: Average End to end Delay V/S node Density

Figure 8: Average Jitter V/S Mobility

Figure 6: Average Throughput V/S Mobility

Figure 9: Average Jitter V/S node Density
Performance results of packet delivery ratio are shown in Figure 2 and 3. Figure 2 shows packet delivery ratio of routing protocols according to the increase of node’s maximum speed. As the nodes maximum speed increase, a packet delivery rate of proactive and reactive protocols decreases. Figure 3 depicts effect of variation in node density on packet delivery ratio. The packet delivery ratio in both the cases (proactive and reactive protocols) proportionately varies with variation in node density. However reactive routing protocol shows better performance.

Figure 4 and 5 shows simulation results on the aspect of average end-to-end delay performance for reactive and proactive routing protocols by varying the node’s maximum movement speed and the node density (number of nodes). The average end-to-end delay of packet decrease as node’s maximum speed increases in case of reactive but it is less in proactive routing protocols. This is due to size of the overhead packets are large in reactive routing protocols than the proactive routing protocols.

It is observed that the Throughput for proactive and reactive routing protocol in Figure 6 and 7 is very similar in low mobility and reactive protocols has higher throughput compared to proactive in high mobility of the nodes.

Figure 8 and 9 shows the simulation results for the jitter produced whenever we vary the node’s maximum movement speed and node density in the network. The increase in the movement speed and node density proactive protocols has the less jitter compared to the reactive protocols.

6. CONCLUSION
DSR may be preferred in the situations where End-to-End delays are very critical. Proactive protocols perform well in low/ medium node density where as Reactive performs well for high density environment. The proactive routing protocols performs better when the density of the network is less, as the density and mobility of nodes increases the performance of the reactive protocols are better than the proactive protocols.

In our simulation results, on-demand routing protocols DSR perform well in high maximum speed and high density then the table-driven (Proactive) routing protocol, OLSR shows the worst performance because its periodic route update and hello messages become the severe overhead in highly mobile and dense network.

References