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ANALYSIS OF MANET SECURED ROUTING PROTOCOLS

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ABSTRACT:

The growth in the use of wireless communications over the last few years is quite substantial and as compared to other technologies, it's huge. The primary advantage of a wireless network is the ability of the wireless node to communicate with the rest of the world while being mobile. For Ad Hoc routing protocols, there are certain specific requirements specific requirements. First of all, such protocols must be distributed, because depending on a central host to make the routing decisions introduces a bottle neck or even to a single point of failure considering the limited resources of the mobile nodes. Secondly, they must be adaptive to the continuously changing topology due to mobility. Thirdly, they must compute the routes in a fast, loop free, optimal resource usage and up to date fashion. Additionally, they must keep the process of route maintenance as local as possible. Finally, they should provide some degree of quality of service (QoS) and keep as much helpful information as possible about only the local and stable network topology.

1. INTRODUCTION

Wired and wireless networks each have advantages and disadvantages; depending on your needs, one may serve you better than the other. Wired networks provide users with plenty of security and the ability to move lots of data very quickly. Wired networks are typically faster than wireless networks, and they can be very affordable. Wireless network is a network set up by using radio signal frequency to communicate among computers and other network devices. Sometimes it's also referred to as WiFi network or WLAN. The growth in the use of wireless communications over the last few years is quite substantial and as compared to other technologies, it's huge. The primary advantage of a wireless network is the ability of the wireless node to communicate with the rest of the world while being mobile. Two basic system models have been developed for the wireless network paradigm. The fixed backbone wireless system model consists of a large number of mobile nodes and relatively fewer, but more powerful, fixed nodes. These fixed nodes are hard wired using landlines. The communication between a fixed node and a mobile node within its range occurs via the wireless medium. However, this requires a fixed permanent infrastructure, another system model, the *mobile ad hoc network.*

Mobile ad hoc networks (MANETs) [1, 2] are collections of mobile nodes, dynamically forming a temporary network without pre-existing network infrastructure or centralized administration. These nodes can be arbitrarily located and are free to move randomly at any given time, thus allowing network topology and interconnections between nodes to change rapidly and unpredictably. Node mobility can vary from almost stationary to constantly moving nodes, depending on the particular network's structure and purpose. As a general rule, high mobility usually results in low link capacity, whereas low mobility leads to high capacity links. The very dynamic nature of mobile ad-hoc networks creates great challenges for routing protocols. As MANET networks are infrastructure less there exist no dedicated routers. Instead, every mobile node acts itself as a router and is responsible for discovering and maintaining routes. Furthermore, without centralized administration, MANETs can be called autonomous. To support this kind of autonomy, the routing protocol is required to automatically adjust to frequent environment changes. The primary goal of the routing protocol is correct and efficient route establishment to facilitate communication within the network between arbitrary nodes. To successfully fulfill this task, the routing protocol must take the unique characteristics of MANET networks into account.

There are generally purely proactive and purely reactive approaches to implement a routing protocol for a MANET but they have their disadvantage. To overcome this a new approach hybrid routing protocols came into existence by taking the advantage of both proactive and reactive in hybrid schema, taking advantage of proactive discovery within a nodes local neighborhood, and using reactive protocol for communication between these neighborhoods. The presented paper represents the simulation on wired and wireless network by varying the pause time and node speed of TORA, DYMO and DBF routing protocols and also compare the performance of these protocols.

2. PROBLEM DESCRIPTION

The objective is to evaluate proposed routing protocols for mixed networks through in given network based on performance. This evaluation should be done theoretically and through simulation. In this work, we have used a mixed network for comparing different reactive, proactive and geographical protocols and evaluate its performance with respect of variations in nodes speed and pause time between the nodes.

3. ROUTING CONCEPT

Routing is the act of moving information from source to a destination in an internet work. During this process, at least one intermediate node within the internetwork is encountered. The routing concept basically involves two activities: firstly, determining optimal paths and secondly, transferring the information groups (called packets) through an internetwork. The latter concept is called as packet switching, which is straight forward, and path determination is very complex.

Routing protocol uses several matrices to calculate the best path for the routing the packet to its destination. These matrices 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. The process of path determination is that, routing algorithms initialize and maintain routing tables, which contain the total route information for packet. This route information varies form one routing algorithm to another. Routing tables are filled with a variety of information which is generated by routing algorithms. Most common entries in the routing table are ip-address prefix and the next hop. Routing tables Destination/next hop associations tell the router that a particular destination can be reached optimally by sending the packet to router representing the "next hop" on its way to final destination and ip-address prefix specifies a set of destinations for which the routing entry is valid for.

Node mobility has greatest impact on available routes. Mobility leads to dynamic topologies of the network which enforces nodes to update their neighbor information and associated routes to a node. Different routing protocols update this information in different ways. The primary goal of routing protocols in ad-hoc network is to establish optimal path (min hops) between source and destination with minimum overhead and minimum bandwidth consumption so that packets are delivered in a timely manner. A MANET protocol should function effectively over a wide range of networking context from small ad-hoc group to larger mobile Multihop networks.

4. ROUTING PARAMETER

4.1 NETWORK SIZE: Measured in number of Nodes.
4.2 NETWORK CONNECTIVITY: The average number of neighbor of a node.
4.3 TOPOLOGICAL RATE OF CHANGE: The speed with which network topology is changing
4.4 LINK CAPACITY: Effective link speed measured in bits/ second, after for losses due to multiple accesses, coding framing, etc.
4.5 FRACTION OF UNIDIRECTIONAL LINKS: How effectively does a protocol perform as a function of the presence of unidirectional links.
4.6 TRAFFIC PATTERNS: How effective is a protocol in adopting to non – uniform traffic patterns.
4.7 MOBILITY: When, and under what circumstances, is temporal and spatial topological correlation relevant to the performance of routing protocol? In these cases, what is the most appropriate model for simulating node mobility in a MANET?
4.8 FRACTION AND FREQUENCY OF SLEEPING NODES: How does a protocol perform in the presence of sleeping and awaking nodes?

5. DESIRABLE PROPERTIES OF ROUTING PROTOCOL

If the conventional routing protocols do not meet our demands, it needs a new routing protocol. These are some of the properties that are desirable:

5.1DISTRIBUTED OPERATION

The protocol should of course be distributed. It should not be dependent on a centralized controlling node. This is the case even for stationary networks. The difference is that nodes in an ad-hoc network can enter/leave the network very easily and because of mobility the network can be partitioned.

5.2 LOOP FREE

To improve the overall performance, it is required that the routing protocol to guarantee that the routes supplied are loop-free. This avoids any waste of bandwidth or CPU consumption.

5.3 DEMAND BASED OPERATION

To minimize the control overhead in the network and thus not wasting network resources more than necessary, the protocol should be reactive. This means that the protocol should only react when needed and that the protocol should not periodically broadcast control information.

5.4 UNIDIRECTIONAL LINK SUPPORT

The radio environment can cause the formation of unidirectional links. Utilization of these links and not only the bi-directional links improves the routing protocol performance.

5.5 SECURITY

The radio environment is especially vulnerable to impersonation attacks, so to ensure the wanted behavior from the routing protocol; it needs some sort of preventive security measures. Authentication and encryption is probably the way to go and the problem here lies within distributing keys among the nodes in the ad-hoc network.

5.6 POWER CONSERVATION

The nodes in an ad-hoc network can be laptops and thin clients, such as PDA's that are very limited in battery power and therefore uses some sort of stand-by mode to save power. It is therefore important that the routing protocol has support for these sleep-modes.

5.7 MULTIPLE ROUTES

To reduce the number of reactions to topological changes and congestion multiple routes could be used. If one route has become invalid, it is possible that another stored route could still be valid and thus saving the routing protocol from initiating another route discovery procedure.

5.8 QUALITY OF SERVICE SUPPORT

Some sort of Quality of Service support is probably necessary to incorporate into the routing protocol. This has a lot to do with what these networks will be used for. It could for instance be real-time traffic support. None of the proposed protocols from MANET have all these properties, but it is necessary to remember that the protocols are still under development and are probably extended with more functionality. The primary function is still to find a route to the destination, not to find the best/optimal/shortest-path route. The remainder of this chapter will describe the different routing protocols and analyze them theoretically.

6. EMPIRICAL ANALYSIS

Simulation is a fundamental tool in the development of MANET protocols, because the difficulty to deploy and debug them in real networks. The simulation eases the analyzing and the verification of the protocols, mainly in large-scale systems. It offers flexible testing with different topologies, mobility patterns, and several physical and link-layer protocols. However, a simulation cannot provide evidence in real-world scenarios, due to assumptions and simplifications that it makes. Therefore, the results obtained from the simulations should be evaluated appropriately. The nature of mobile ad hoc networks makes simulation modeling an invaluable tool for understanding the operation of these networks. Routing protocols in ad-hoc network experience a high variability in the performance under certain condition with certain parameter. While real world tests are crucial for understanding the performance of mobile network protocols, simulation provides an environment with specific advantages over real world studies. This aids in deeper under- standing of how the changes impact the performance results.

QualNet is a discrete event simulator developed by Scalable Networks. It is extremely scalable, accommodating high fidelity models of networks of 10's of thousands of nodes. QualNet makes good use of computational resources and models large-scale networks with heavy traffic and mobility, in reasonable simulation times.

6.1 ANALYSIS OF 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. It is the ratio between the numbers of sent packets vs. received packets.

Table1: Throughput of DBF, TORA and DYMO

PAUSE TIME VS THROUGHPUT			
Pause time	DBF	TORA	DYMO
10	1897	3591	3626
20	1983	3380	3413
30	1940	2915	3332
40	772	2915	3218
50	1378	3253	3260

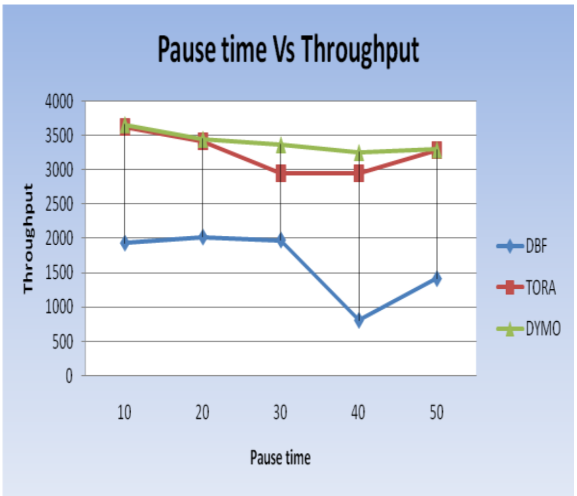

Fig. 1 Throughput vs Pause Time

Table 1 shows the readings of throughput for DBF, TORA and DYMO in variation in pause time. It is observed that in figure6.1 throughput of DYMO is better than DBF and TORA protocol when pause time is kept 10, 20, 30, 40 and 50.

One of the issues with link state protocols is that**,** if the protocol is unable to converge, there are large disconnects in the known network topology and many packets are dropped due to lack of sufficient routing information. In order to save bandwidth, DBF and TORA does not guarantee shortest path but if the path is optimal than it shows the good performance than other so that it result vary as shown in figure 1. The conclusion of above graph is that the DYMO can maintain the constant throughput with varying the pause time, but reactive protocol are able to maintain the throughput as the area of network vary.

6.2 ANALYSIS OF END-TO-END DELAY

Average End to End Delay signifies the average time taken by packets to reach one end to another end (Source to Destination).

Table 2. End-to-End Delay of DBF, TORA and DYMO

Pause time Vs Average End-to-End Delay (s)			
Pause Time	**DBF**	**TORA**	**DYMO**
10	0.0102271	0.0136647	0.0498071
20	0.011967	0.0215305	0.0442237
30	0.0112848	0.105291	0.0526523
40	0.0123722	0.0248991	0.0295303
50	0.0157486	0.0352392	0.0132992

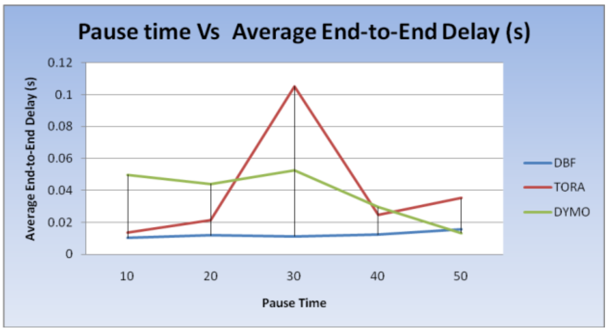

Fig. 2 End to End delay vs Pause Time

Table 2 and Figure 2 shows the Effects of end to end delay with variation in pause time. It is observed that DYMO performs better than TORA, but DBF has less end to end delay. DYMO has higher end to end delay when pause time is 10. From above graph it can be conclude that DYMO performs well when pause time is 50s.

6.3 ANALYSIS OF TOTAL PACKETS RECEIVED

Total packets received are no. of packets received when sent from source to destination

Table 3. Total Packets Received having variation in pause time.

Pause time Vs Total Packets Received			
Pause Time	**DBF**	**TORA**	**DYMO**
10	44	82	85
20	46	80	72
30	45	69	76
40	33	69	79
50	32	77	75

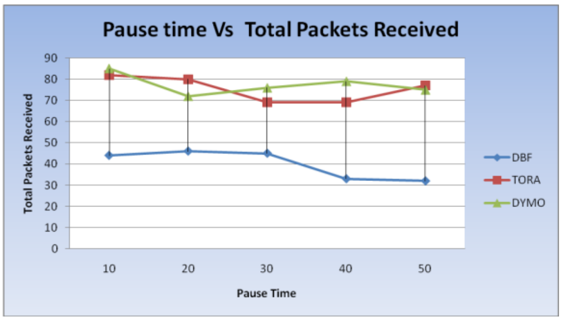

Fig.6.3 Pause time Vs Total Packets Received

Figure 6.3 show total packet received with variation in pause time. It can be observed that performance of DYMO is better than other protocol. DYMO can receive packet due to better routing technique. It is also observed that there is fewer packets have received when pause time is 20s. the reason behind it is the signal coverage or mobility of nodes.

6.4 ANALYSIS OF AVERAGE JITTER WITH VARIATION IN PAUSE TIME

Average Jitter effect signifies the Packets from the source will reach the destination with different delays. A packet's delay varies with its position in the queues of the routers along the path between source and destination and this position can vary unpredictably.

Table 4. Information regarding the Average Jitter having variation in pause time

Pause time Vs Average Jitter (s)			
Pause Time	**DBF**	**TORA**	**DYMO**
10	0.002338	0.003102	0.003621
20	0.002243	0.002454	0.002435
30	0.002269	0.002358	0.002344
40	0.00231	0.002647	0.002501
50	0.003755	0.003447	0.002859

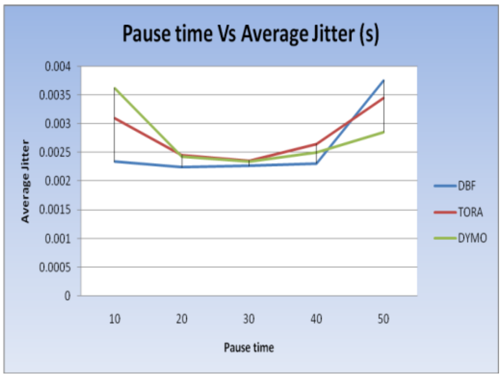

Fig. 6.4 Pause time Vs Average Jitter (s)

From above Figure 6.4 it is estimated that Avg. jitter effect in DBF, TORA and DYMO changes by increasing or decreasing the pause time. The Jitter effect decreases as the pause time increases. But when it becomes 50s average jitter increases for each protocol. In these three protocols DYMO perform better.

7. CONCLUSIONS

This paper presents a comprehensive study of three routing protocol TORA, DYMO and DBF in different scenario. These three routing protocols are analyzed in mixed network in the presence of some misbehaving nodes. Mixed network is the combination of wired network and wireless network. After creation of scenario of mixed network and misbehaving nodes, above three protocols are simulate on QualNet 4.5. In simulation pause time of nodes varies and speed of node is constant and vice versa. After the several simulation runs and their analysis, it was observed that DYMO can perform better in almost all situations, which is further proven by comparing results with protocols. DYMO can give better results in high density network where nodes move with different speed and with different pause time. TORA also performed better in some conditions, but the results were not promising in all cases. As DBF is a wired network protocol, the performance was neither expected nor worked well in wireless network scenario. The performance of DBF was less than performance of DYMO and TORA.

This work focused only on the network throughput, delay, maximum packets received and average jitter effect. It would be significant to consider other metrics like power consumption, the number of hops to route the packet, fault tolerance, minimizing the number of control packets etc. The work can be extended by nitty-gritty study of routing protocols in a fault tolerant approach with proper simulation set up with parallel real time environment for mobile and wireless ad hoc networks.

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