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Abstract - A Mobile Ad hoc Network (MANET) are classified as single or multihop wireless network in which nodes can freely move and dynamically self-organize, also the network is highly dynamic in terms of topological changes. Mobile nodes can communicate with themselves without any need of predefined infrastructure. But due to the dynamic nature of MANETs in terms of mobility and no infrastructure, they are provided with limited bandwidth and limited battery power. Due to these characteristics, the MANETs are best suited for military operations, in battlefield grounds, Disaster relief and rescue operations. Choosing the mobility model is very much crucial for specific application area that represents the moving behaviour of a mobile node that should be realistic. Changing the mobility scenario, allows changes in routing performance of a routing protocol in terms of routing metrics such as Delays, Throughput, and Routing Overhead etc within the current application area. Main aim of this research paper focus to study the effects of Transmission Control Protocol TCP and Constant Bit Rate CBR from different angles over Dynamic MANET on demand routing protocol known as DYMO in order to find out the performance degradation on the basis of Data packets and Control packets. Using the Network Simulator 2, experimental results show that functions of the routing protocol vary across different parameters like sending and receiving ratio of data packets and numbers of Control packets send during the simulation period.

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GJCST Classification : C.2.6, C.2.2

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Measuring the Effect of CBR and TCP Traffic Models over DYMO Routing Protocol

Muhammad Inayat Ullah[α],Nasir Nawaz[Ω]

Abstract - A Mobile Ad hoc Network (MANET) are classified as single or multihop wireless network in which nodes can freely move and dynamically self-organize, also the network is highly dynamic in terms of topological changes. Mobile nodes can communicate with themselves without any need of predefined infrastructure. But due to the dynamic nature of MANETs in terms of mobility and no infrastructure, they are provided with limited bandwidth and limited battery power. Due to these characteristics, the MANETs are best suited for military operations, in battlefield grounds, Disaster relief and rescue operations. Choosing the mobility model is very much crucial for specific application area that represents the moving behaviour of a mobile node that should be realistic. Changing the mobility scenario, allows changes in routing performance of a routing protocol in terms of routing metrics such as Delays, Throughput, and Routing Overhead etc within the current application area. Main aim of this research paper focus to study the effects of Transmission Control Protocol TCP and Constant Bit Rate CBR from different angles over Dynamic MANET on demand routing protocol known as DYMO in order to find out the performance degradation on the basis of Data packets and Control packets. Using the Network Simulator 2, experimental results show that functions of the routing protocol vary across different parameters like sending and receiving ratio of data packets and numbers of Control packets send during the simulation period.

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I. Introduction

The networks without wire become increasingly popular in the industry of network. They can provide mobile users the possibilities of communication and the omnipresent access of information independently of the places. Conventional networks without wire are frequently connected to a network of cable so that Asynchronous Transfer Mode or connections of Internet can be prolonged to the mobile users. This type of wireless network requires a fixed infrastructure of backbone of cable networks. Mobile hosts that are in communication can access a base station on the network of cable in the radio transmission.

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Conventional networks without wire, has another kind of model, depend on the radio-to-radio multi hoping, which neither of the fixed basic stations nor an infrastructure of has wired backbone. In some situations, for example, battlefield and disaster recovery etc.

The network of cable is not accessible and the multi-hop networks offer the only possible means for the communication and the accessing of the information. These types of networks are known as wireless ad hoc networks (MANET). They can also b implemented in civilian forums for example conferences, E-classrooms and campus recreation etc. (Tonnesen, 2005).

The mobile host and the wireless equipments are largely available commercially. However, many of the components of wireless networks are used and deployed in traditional networks like Internet. Often sometimes, the mobile users can want to communicate the others without barriers of the fixed infrastructure like the fixed backbones or confined in a certain sector. For example, a group of students can want to communicate the ones who want to share some lecture material and notes in the conference or tasks etc; the friends or the associates of businesses can meet and share or want to divide some files; a certain team of re-establishment or disaster can want to install a network in a certain urgency in order to share the details of the situation with the others. In such situations, a provisional network can be installed without centralized infrastructure. They are some examples where MANETs can be used effectively and efficiently.

II. MANETs

In the past and recent years, the usage of wireless devices becoming more and more important and necessary due to rise of mobile and wireless networks. There are three types of mobile networks are present. i.e. infrastructured, infrastructured less and hybrid networks.

An infrastructured network (Figure 1.1(a)) is composed of nodes, which are mobile in nature. That type of network also consists of one or more bridges, which forms a connection between the wireless networks to the wired networks. These bridges are basically called base stations. Whenever a mobile node wants to connect with a base station it searches for the nearest base station within its range and connects with it and starts communication. A mobile node can connect with any base station within its locality, but ultimate choice would be the one which has strong signal strength.

The base station is a centralized point from where the wireless node communicates with any other wireless node. i.e. without the base station any node cannot communicate with the other node. Whenever the mobile node gets out of the radio range it comes in roaming mode, and this process is called handover or handoff. A handover is a process in which a mobile node registered itself with a new base station.

On the other hand, infrastructure networks or ad hoc networks do not depend upon any infrastructure. There is no need of base stations, routers, bridges or any other equipment that is necessary for communication between wireless nodes.

The mobile nodes select its destination and moves towards it and their topology is totally dynamic in nature. The packet travels form hop to hop and upon reaching the destination. These mobile nodes are also called or behave as routers. The routes are discovered and routing tables are generated and maintained at each node, which shows the picture of the entire network. The mobile ad hoc networks are extremely important in the area that lacks the infrastructure. Such as rescue and emergency situations, where rescue team wants to communicate the information quickly. Other examples include the meeting material and notes communication among conference members within the conference room, and Internet usage at the airport or subway station etc.

Figure. a : An infrastructure network with two base stations

Figure. b : A mobile ad-hoc network

A hybrid network consists of both properties and characteristics of infrastructure and infrastructure less network. It also makes use access points for communication and also supports the lack of infrastructure when necessary.

An ad hoc network environment is dynamic in nature. Dynamism can be seen not only in the case of nodes but also in the form of link with allocated bandwidth.

Furthermore, MANET supports and makes use of asymmetric links. i.e. links with different uplink and downlink bandwidth and date rate as shown in Figure-1. The Node A is in the radio range of node B, while node B is not within the transmission range of node A, thus the link has different uplink and downlink values. There are other factors for asymmetric links i.e. a higher signal -to-noise ratio for node A than for node B.

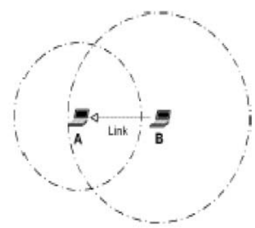

Figure. 1: Asymmetric Link (Corson and Macker, 1999)

III. Mobility Models

There are many mobility models proposed for the movement of nodes within the environment. All of these models are developed by keeping in view the speed and direction of nodes. These Mobility models pictured the mobility pattern that the node follows when moves within the area. The Mobility Model is modeled for urban, disaster, emergency, conference and traffic scenarios. There are two main types of Mobility Model, i.e. Entity based and Group based.

a) *Random Waypoint Mobility Model (RWP)*

This Random Waypoint motion is one of the types of Entity Mobility Model as shown in the Figure 1.3. One the main property of a RWP is that recent movement of a mobile node does not depends upon the past movement or we can say it is stateless in nature and hence there exist no limits enforced on the max deviation which the nodes can get up for their next movement. This arbitrariness chosen by the mobile nodes causes unpredictable motion in selecting the next direction vector.

At the start, each mobile node selects its destination which is randomly selected within the simulation field. Mobile node than moves and travels towards it with a constant uniform velocity from [0,Vmax], the Vmax denotes the maximum allowable velocity. However, node chooses the velocity and direction independent of other nodes. When a node reaches the destination, the node stops and stays for a time that is called as the “pause time” i.e. Tpause. If value of Tpause is 0, then node leads to continuous mobility.

After some time, the mobile node again selects a new random destination within the simulation environment and travels towards it. This process is continuously repeated until the simulation ends. This type of behaviour forms a Zig Zag pattern, in which nodes converges, disperse and converge again. In the Random Waypoint Model, the mobility behaviour of nodes is controlled using two variables i.e. Vmax and Tpause. If the value of Vmax is small and the Tpause is large, the network becomes fairly stable. While, the Vmax is large and the Tpause is small, the network or topology seems to be dynamic. By changing the values of these two variables, various mobility scenarios can be created with respect to different velocity and pause time.

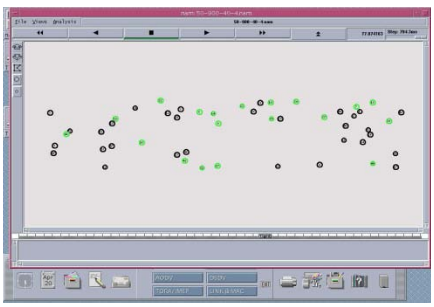

Figure 1.3 : Snapshot of a typical movement scenario observed in random waypoint model with 50 nodes in Network Simulator (Sadasivam et al., 2002)

IV. Performance Metrics

To evaluate the performance of the routing protocols following metrics are used.

a) Packet Delivery Ratio (PDR)

The packet delivery ratio is defined as the number of data packets received to the number of data packets sent by the CBR/TCP source The PDR is normally computed in terms of percentage

b) Normalized Routing Load (NRL)

Normalized Routing load is defined as the ratio between the numbers of the routing or control packets transmitted per data packet received at the destination.

c) Optimal Hop Count (HC)

It is defined as the ratio between MAC packets transmissions to the Agent layer transmissions.

d) Routing Overhead (RO)

It is defined as the total amount of routing packets transmitted from source to the destination during the simulation. RO can be computed in form of number packets or number of bytes.

V. Simulation Scenario

In This Research four simulation scenarios used to measure the effect of CBR and TCP traffic models over DYMO routing protocol and result of the scenario is shown in the bellow figures of the scenario.

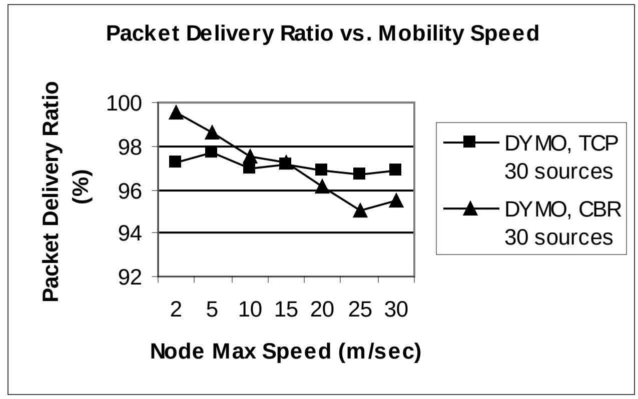

Figure 3.1 : Packet Delivery Ratio versus Node Max Speed for DYMO (Number of Nodes=20, Traffic= CBR and TCP, Area space= 300m x 400m)

In the scenario, the number of nodes set to 20 moving randomly with the speed varied from 2 m/sec to maximum of 30 m/sec within the topological area of 300mx400m. The traffic types i.e. TCP and CBR are selected with number of sources is set to 30 at rate of 2 packets/second respectively. Reference to above figure 3.1, it is seen that the DYMO showed highest PDR of 99.5% using CBR traffic, but the PDR quickly drops as mobility speed varies from 2 m/sec. However, in case of using TCP, DYMO showed good and stable PDR of 98% at speed 5 m/sec respectively. The reason is due to that DYMO the rapid change in topology causes route changes and ultimately causing updation in routing table. In case of TCP traffic, more guarantee ness is provided so DYMO behave excellently and packet delivery ratio is up to consistent 97% at high mobility speed.

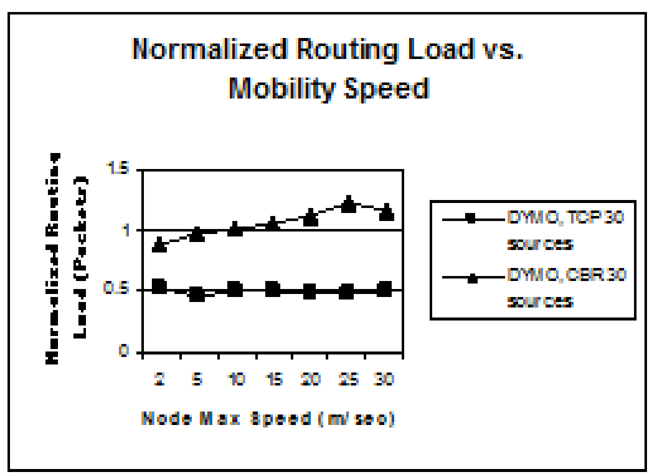

Figure 3.2 : Normalized Routing Load versus Node Max Speed for DYMO (Number of Nodes =20, Traffic= CBR and TCP, Area space= 300m x 400m)

The figure 3.2 illustrated the graph for Normalized Routing Load for DYMO protocol. DYMO behaves well in terms of Normalized Routing Load using TCP traffic. However, using CBR traffic, DYMO has consistent and high control traffic during Route discovery phase and also control packet send per each data packet received by the destination that give raise its overall Normalized Routing Load.

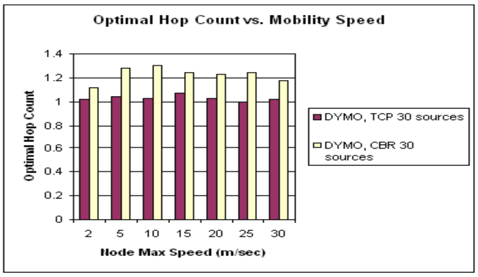

Figure 3.3 : Optimal Hop Count versus Node Max Speed for DYMO (Number of Nodes=20, Traffic= CBR and TCP, Area space= 300m x 400m)

The figure 3.3 illustrated the Hop count of DYMO for 20 nodes. The graph showed the best optimal hop distance from source to the destination for this protocol. In case of TCP traffic, packets reach the destination in least number of hops using DYMO due to guarantee ness and stable routes entries in the routing tables.

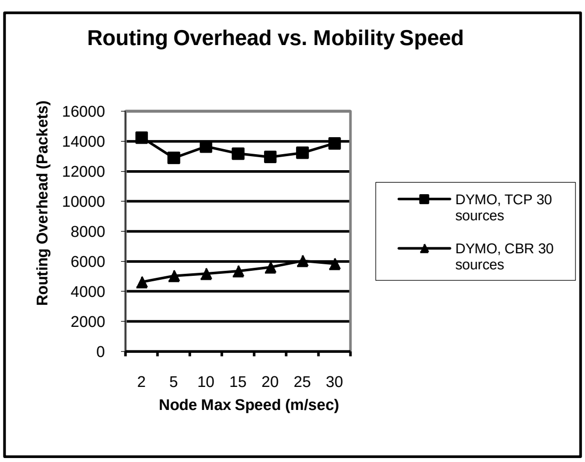

Figure 3.4 : Routing Overhead versus Node Max Speed for DYMO (Number of Nodes=20, Traffic= CBR and TCP, Area space= 300m x 400m)

The figure 3.4 illustrated the Routing Overhead of DYMO using CBR and TCP traffic for 20 nodes. It is seen that the Routing Overhead of DYMO is more and high using either traffic types, due to Route Request and Route Reply messages during Route discovery phase.

VI. Conclusion

This research paper is focus to analyze the characteristics of DYMO by varying traffic types, number of nodes and topological areas. DYMO performs excellently in terms of Packet Delivery Ratio, even by increasing number of nodes and area. However, DYMO showed ups and downs in Packet Delivery Ratio using either traffic patterns, especially using CBR traffic. In case of Packet Delivery Ratio, DYMO is better suited to TCP traffic than CBR. However, DYMO performs poorly in terms of Normalized Routing Load and Routing Overhead using either traffic types. The change of speed has more impact on DYMO, due to the fact that rapid change in topology causes change in node links and routing tables. DYMO uses multi-path, and uses multiple as well as single paths from source to destination. DYMO has more control overhead during the route discovery process and also due to the HELLO messages exchange. The increased control overhead of DYMO also leads to increase Normalized Routing Load, which is a ratio between numbers of control packets send to number of CBR/TCP packets received at the destination. In case of Optimal Hop Count, the DYMO uses shortest number of hops to send the packets from source to the destination using TCP. DYMO have good Packet Delivery Ratio and Hop Count but have draw back of increased Normalized Routing Load and Routing Load.

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