A Review For Uniqueness And Variations In Throughput Of MANET Routing Protocol Due To Performance Metrics, Characteristics And Simulation Environments

M.SULLEMAN MEMON
Department of Computer Systems Engineering/Information Technology
Quaid e Awam University of Engineering,Science and Technology
Sakrand Road, Nawabshah
PAKISTAN
sullemanmemon@hotmail.com,

MANZOOR HASHMANI
Department of Computer Systems Engineering/Software Engineering
Mehran University of Engineering and Technology
Jamshoro
PAKISTAN
mhashmani@yahoo.com

NIAZ A.MEMON
Department of Computer Systems Engineering/Information Technology
Quaid e Awam University of Engineering,Science and Technology
Sakrand Road, Nawabshah
PAKISTAN
drniaz_ahmed@hotmail.com

Abstract: Very prestigious work has been performed in the field of mobile ad hoc networks (MANETS) with respect to their routing protocols. Researchers have developed and designed so many protocols for these networks, but due to the dynamic change in topology, decentralization, power management, bandwidth and many other factors like these no specific routing protocol is exclusively recommended, up to today, which comply and fulfill all the needs and requirements of users for ad hoc networks in all situations of network variation statuses and traffic overhead. This paper contributes an effort towards anthology of one of the major segment of routing protocols i.e. unicast, their categories and the main type of unicast routing protocols such as DSDV from proactive plus DSR from reactive. The protocols and their performances are evaluated on the basis of some metrics commonly used in support of simulation environment for getting simulation results acquired by simulation of certain model with some parameters with the help of NS-2, OPNET and GloMoSim like simulators. The performance evaluations are declared on the basis of those simulations results, but all the results peter out when magnitudes of those attributes or load of network changes (increased or decreased) with respect to bandwidth, power management, end to end delay, data errors, packet dropping ratio or even with distance. Here in this paper we have scrupulously reviewed the work done on these protocols and majority of the simulated results are examined and finally suggest few common uniqueness and differences with respect to their properties which remain unchanged in all the situations and scenarios.

Keywords: Multicasting Capability, Route Metric, Beaconing, QoS Support, Structure, Security Support

1. Introduction

Mobile Ad hoc networks are independent of pre-established infrastructure; they have benefits like flexibility and easy deployment, robustness which make them interesting and stretchy technology. MANETs consists of wireless mobile nodes which dynamically exchange data among themselves with out the reliance of fixed base station or wired backbone [4]. In recent years, application domains of mobile ad hoc networks gain more and more importance [1] because they are rapidly deployable with out prior planning and any infrastructure, nodes are free to move randomly so the topology may change rapidly and unpredictably. In Public sector institutes, business, print media and industrial zones they are used with high speed, short range network with respect to communication applications, where as in military applications they are used as low speed, long rang networks. The typical application scenarios include the rescue missions, the law enforcement operations, the cooperating industrial robots, the traffic management, and the educational operations in campus [1]. Ad hoc networks present many challenges including the design of protocols for mobility management, effective routing, data transport, security, power management and QoS[7]. In MANETs, hence each host has to act as router itself and routing protocols for the network runs on every host and is therefore subject to the limit of resources at each other. As routing between the nodes to find a path from source to destination is a key feature in multi hop MANETs, therefore a large number of routing protocols have been designed for the different scenarios of different requirements in short time during the recent past.. To make a decision about the protocols that which one is good is not an easy task because it depends upon the conditions of network. There fore no protocol is ideal for all scenarios.

To design a routing protocol for MANETs have became a difficult and challenging job for researchers, due to some inherent complications of ad hoc networks. The high mobility and low bandwidth features make it necessary for the routing protocol to be dynamic and bandwidth efficient to enable the delivery of data packets while producing low control overhead due to the movement of hosts the network changes its topology very dynamically that results errors on rout and packet drop which eventually causes an effect on through put, topology changes and network partitions in MANETs. Due to the variable and unpredictable capacity of wireless links, packet losses may happen frequently. As promising network of future applications, mobile ad hoc networks are attracting more and more researchers [1]. In this paper we have given a review of uniqueness and variations in throughput due to performance parameters of typical unicast routing protocols for MANETs and have compared these selected protocols and their presentation with certain attributes on the behalf of their similarities and differences. At best of our knowledge this type of work in this pattern and shape is not published any where, particularly about these specific protocols. The authors are hopeful that paper will provide the facility to researchers to have all proportionalities about these protocols at one place in summarized way.

2. Related Work

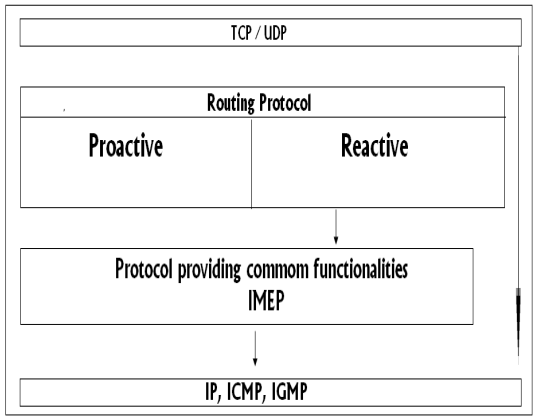
Routing Protocols

A user can move frequently in ad hoc network scenario and as result network needs to have routing protocol which can adopt dynamic changing topology [3]. To accomplish this traditional routing protocols on link state based or distance vector algorithms are not suitable for ad hoc networks , Because due to constantly change of position, it is quite difficult to maintain the entire networks routing information accurately and thus guarantee message

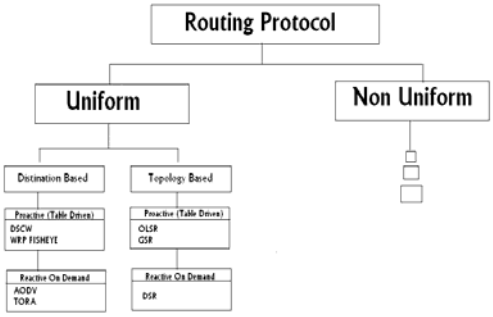
delivery[8]. Therefore dynamic multi hop paths are constructed to route message while mobile nodes cooperate wondering. Plus the low bandwidth features of ad hoc network make it necessary for a routing protocol to be bandwidth efficient to enable to delivery of data packets while producing low control overhead. To meet these and other requirements, IETF is busy to develop framework for routing for ad hoc networks[9]. Today a number of routing protocols are available to serve the above discussed cause. Such protocols are defined as proactive or reactive depending on whether they keep routs continuously updates or whether they react on demand .In Fig.No.1 below we have given the hierarchy and classification of MANET routing protocols. Table driven protocols are called actually proactive protocols in which continuous connectivity is maintained before the packet needs to be forwarded. This is able to offer routing information on the spot. Since node movement may be fast and topology changes may be more frequent than route request, pure proactive protocols are not suitable for ad hoc networks because they continually use a large portion of the network capacity to keep rout information maintenance. DSDV is example of this. On the other hand on demand protocols are called source initiated reactive protocols in which route determination is invoked only on demand. For this a flooding mechanism is employed when ever a route is requested. Due to this need based request, the delay to find route can be quite significant issue. DSR is example of this type. Here in Table No.1 we have described the bold differences between two categories of protocols

2.2 Design Considerations

Table-driven routing protocols demand that each node should have up-to-date information, recorded in a routing table, of all mobile nodes in the network. To achieve this goal, whenever any mobile node moves, the new routing table has to be broadcast to all nodes. Moreover, it has to



(a)



(b)

Fig. No.1: (a) Hierarchy of Routing Protocols (b) Classification of MANETS Routing Protocols

periodically exchange the routing table by broadcasting and by propagating an update to all nodes in the network to keep track of the newest messages even though the network topology does not change. Each mobile node has routing information about all nodes of the whole network though most of it is unnecessary. As the number and the moving speed of mobile nodes increase, the size of the routing table and the number of routing table updates increase. Such protocols waste precious wireless bandwidth on control overhead.

However, on-demand routing protocols have a totally different approach;

they create routes only when needed by source nodes. When a node requires a route to the destination, it initiates a route construction procedure [4]. A route maintenance procedure is triggered whenever a route has been constructed and is in progress until any node in the route is unreachable or the route is no longer required. The control messages used in on-demand routing protocols only record the desirable data on the route such as nodes on the route and other performance metrics and so forth. By excluding any undesirable data on control messages, on-demand routing protocols greatly reduce the size of control message as compared with table-driven routing protocols, and they can withstand the increasing number of mobile nodes.

3 Simulating Protocols

3.1 Performance Parameters

It is observed that to make a decision about the selection of routing protocol to best suit for ad hoc networks scenarios, simulation are performed on that protocol with different conditions of network called model. When ever research is carried out with respect to have best results or comparative analysis, it is made mostly on the basis of performances. It is always done on the behalf of some performance parameters which are utilized in routing protocols for simulation purposes. Different researcher use different parameters to compare. At best of our work here we have given the maximum no of parameters which are utilized at different levels of research at different places. It is not necessary that one have used all at one time but different people have used different parameters according to the requirement of their work with different simulators as NS-2, OPNET , GloMoSim etc with their different versions. Those parameters are : (1) No of hopes per rout, (2) Traffic received and sent, (3) Route discovery time, (4) Total route requests sent , (5) Total route replies sent, (6) Control traffic sent and received, (7) Data traffic sent and received, (8) Retransmission Attempt, (9) Average power, (10) Throughput and (11) Utilization.[4]

The problem with all above parameters is that if they are applied to simulate any protocol with other, they all will always (mostly) give different results if their magnitude or load is changed. Even it is observed that with respect to different version of simulator they produce different result for same protocol

3.2 Simulation Parameters

Although this category of attributes is offered by the simulator (Simulating Software), but here we have tried to collect almost all parameters that are normally used by researchers evaluate the effectiveness of their idea towards claim of being better than the previous. At different levels of work most of the following parameters are used in simulation of routing protocols: (1) Network size (2) Network density (3) No. of nodes (4) Transmission range of nodes (5) Movement speed (6) Pause time (7) Traffic type (8) Sources (9) Packet size (10) transmission rate (11) No. of scenarios (12) Simulation time (13) Roaming area (14) Speed (15) Radius coverage[11].

3.3 Attributes:

In this section we discuss different attributes on the behalf of those a routing protocol can be distinguished, grouped and classified on the basis of certain matrices, from the other types

a) **Platform Classification:** Platforms are of uniform and non uniform of style**.** Uniform scheme is that in which complete network's hosts are equal in role, having same importance and functionality. The protocols discussed here all are of the same uniform or flat platform category.

b) **Network Criteria Metrics:** Most of the routing protocols use hop number as a

Table No:1: Major differences between two types of protocols with respect to main parameters

PARAMETERS	ON-DEMAND	TABLE-DRIVEN
Availability of Routing Information	Available when Needed	Always Available regardless of need
Routing Philosophy	Flat	Mostly Flat except for CSGR
Periodic Route Updates	Not Required	Yes
Coping with Mobility	Using localized route discovery as in AB Rand SSR	Inform other Nodes to achieve consistent
Signaling Traffic Generated	Grows with increasing mobility of active routes (as in ABR)	Greater than that of on-demand routing
Quality if Service Support	Few can support QoS	Mainly shortest Path as QoS metric
Type	Reactive	Proactive
Evaluation of Routs	Rout discovery same global search	Continuously evaluate routes
Latency	Bottle neck due to latency route discovery	No latency in route discovery
Suitability	May no the appropriate for Real Time Communication	Large Network capacity to Keep Information
Use of Information	Routes are created according to need	Most information may never be used

Table No:2: Differences in throughputs for different performance metrics

No	Metric	DSDV	DSR
1	Delay	Satisfactory performance, initially less delay is observed	Initially high delay is occurred but decreases with route establishment
2	Throughput	Very high throughput for dropped packet environment	Initially low due to control packets but later it rises
3	Scalability	With increase in size the performance is degraded with respect to throughput of received packets	Change in no of nodes, it decreases for packet received, but remain constant as network increases
4	Mobility	With respect to received packets, throughput is decreases because packets are sent even before updating of routing tables	Throughput decreases for receiving packets dropped with mobility and after some time increases to appropriate level
5	Jitter	Remain almost constant	Almost zero where route is established
6	Sequence No	Increases with linear increase in packet generation	Increases with linear increase in packet generation
7	Packet Drops	Low with small network but increases as network grows	Almost zero but can rise as simulation time increases

criteria for the path routing. In multi path environment it is suggested to choose the best path with the minimum number of the hop count (with respect to the stability of the link available), one have to look for the chances of failure of link and if chances are same for both short and long paths then it is better to select short path because it also helps to reduce the overhead, probability to drop the packets and smash.

c) Routing Decisions:

i) **Topology based Routing:** Topology of MANET can be controlled by some parameters as transmission power to determine neighbors for a transmitting node plus direction of movement etc. Therefore in routing protocols designed on this technique, nodes make decisions of routing on the basis of collected topology information about the network behaviors.

ii) **Destination based Routing:** In a destination–based routing protocol a node only needs to know the next hop along the routing path when forwarding a packet to the destination [1].

3.4 Proportionality Parameters

The parameters used for proportionality can be grouped into Convolution parameters, Apparatus Individualities and Applicable Scenarios. With the extent literature review and work done in this context we have observed that following are the parameters that researchers have declared with respect to show the proportionalities: (1)Time Convolution (2) Communication Convolution (3) Storage Convolution (4) Destination Updated (5) Periodic Updates (6) Multiple Routes (7) Directional Links (8) Route Metrics (9) Message Requirements (10) Multicasting Capabilities (11) Route Computations (12) Structures (13) Beaconing (14) Flood Control (15) TTL Limitations (16) QoS Support (17) Power Management (18) Security Support and many more.

In the light of above parameters we have gone through a lot of work conducted in this section and as a result have constructed resulting tables which highlights the similarities and differences in a very clear manner.

4. Review And Proportionality

In past the performances of these and many other routing protocols are evaluated on the basis of some simulation techniques with different types of parameters discussed in previous section and we argued by analyzing a lot of research work that the results with respect to performance vary spectacularly with the changing of network condition and traffic transparencies. A no. of papers are available which give performances on the simulation basis by expressing few characteristics but unfortunately results differs with respect to network status, traffic overhead and transmission time etc. Here in this paper the work done on the specific routing protocols is reviewed along with the distinctive individualities and uniqueness presented in section 3.

Here in below section in very brief manner we are going to elaborate few selected routing protocols of same category, in support to all arguments of similarities and differences explained in above section

4.1 Analysis of Proportionalities between DSDV and DSR

In this section first we have given the Fig. No 2 that explain conceptual idea of both categories of routing protocols and then we de have described the protocols, have given their advantages and disadvantages, finally similarities and their differences are given between them.

To discuss and explain each protocol with respect to its design, development, behavior, routing details and constraints etc on each individually is beyond the scope of this paper. Our motive

is to give brief of both categories with respect to their advantages and disadvantages to each other and then proceed for their simulation metrics with respect to the facilities provided by simulators and finally conclude some results on the basis of work conducted by researchers in this regard.

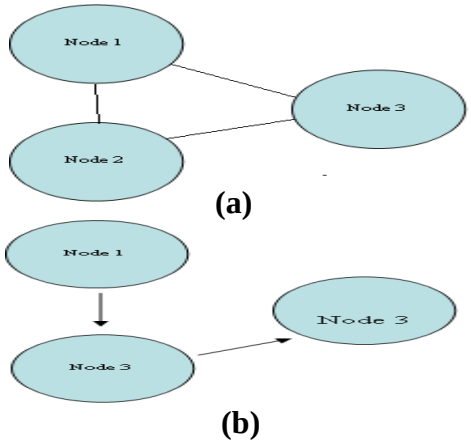


Fig. No. 2: Conceptual Behavior for route generation of (a) DSDV (b) DSR

4.1.1 DSDV

a) Advantages:

1) Simple almost like distance Vector
2) Loop free through destination sequence numbers.
3) No latency caused by route discovery.

b) Disadvantages:

1) No sleeping nodes.
2) Bi-directional links
3) High overhead because most routing information never used.
4) Scalability is main issue.

4.1.2 DSR

a) Advantages:

1) Control overhead can be reduced or minimized by creating a route maintenance mechanism between only those nodes which needs the services to transmit
2) Route cache can also help to cut the overhead burden.
3) More than one routes can be generated by a single route discovery.

b) Disadvantages:

1) Packet header size grows with route length due to source routing.
2) Flood of route request may potentially reach all nodes in the network.
3) Potential collisions between route requests propagated by neighboring nodes.[2]

4.2 Similarities and Differences

In Table No: 2 we have given the maximally observed and collected information of similarities and differences between said proto

cols explained in literature. According best of our knowledge these much number of attributes had never been presented at one place before this.

4.3 Throughput Metrics

Different researchers have observed and analyzed the two categories of routing protocols on different metrics. Through review we have concluded that main from those are seven as: (1) Delay (2) Throughput (3) Scalability (4) Mobility (5) Jitter (6) Sequence Number (7) Number of Packets dropped. In Table No: 3 we have summarized the differences between two protocols according to these metrics.

4.4 Performance Differences:

Gaurav Sethi in [5] has classically reviewed the routing protocols under discussion here, with other protocols and Sampo Naski in [6] has summarized the performance evaluations on the basis of results of simulation experiments conducted by Broch et al, Johanson et al and Perkins et al. They both conclude that DSR and DSDV are lop free, jitter is least in DSR, mobility throughput bin DSR remain almost constant but decreases in DSDV with respect to scalability degradation in performance of DSDV. Therefore they recommend that DSR is suitable for medium size and DSDV for small size networks .Here on the basis of those outputs, we have categorically reproduced those results by separating each one by showing the individual performance of each protocol conducted by an individual

researcher shown in [6]on the basis of Mobility and Load of network. Table No: 3 and 4 shows the summary of each protocol results.

5. Conclusion

Here in this piece of work we review all the possible work done in the section of unicast routing protocol's two main types and look over different conditions, parameters and characters under which they are simulated with different simulators to give performance level up to a required level. We have found certain similarities and proportionalities between these protocols. Here we have compared DSDV and DSR on certain different attributes which are complied under different simulation conditions and parameters. Finally we gave a comprehensive comparison individually of all four routing protocols with respect to their category.

References:

[1] Changling Liu, Jorg Kaiser, "A survey on mobile ad hoc networks routing protocols", Minema, University of Magdeburg, 2005.

[2] Quark," lecture notes on mobile ad hoc network son DSDV and DSR" (4-30-03) http://quark.it.iitb.ac.in/~it644/lectures/notes/manet-notes/dsrdsdv/

[3] Ahmed, S. Alam, M.S. "Performance evaluation of important ad hoc network protocols.(Report)", EURASIP Journal on Wireless Communication, Annual 2006 Issue.

[4] Stephen Muller et al, "multi path routing in mobile ad hoc networks: issues and challenges", 2004

http://networks.cs.ucdavis.edu/~ghosal/Research/publications/stephen-lncs-multipath-survey-paper-2004.pdf

[5] Gaurav Seth et al, "Simulation and Comparison of Communication

TableNo: 3 Comparison b/w DSDV and DSR[1,2,3,4,5,6]

	DSDV	DSR
Update Destination	Neighbors	Source
Update Period	Hybrid	Event Driven
Structure	Flat	Flat
Route Computation	Proactive	Reactive
Multicasting Capability	No	No
Hello Message Requirement	No	No
Route Metric	Shortest Path	Shortest Path
Unidirectional Link	No	Yes
Multiple Routes	No	Yes
Beaconing	Yes	Yes
Flood Control	No	Yes
TTL Limitation	No	Yes
QoS Support	No	No
Power Management	No	No
Security Support	No	No
Route state	DV	Route Cash
Storing mechanism	Neighbors	Accumulation
Query	Forwarding table	Flooding
Reply transmission	Routing table	Uni cost
Intermediate node reply	no of nodes in the networks	Yes
Local partial repair	no of nodes in the networks	Yes
Route Detection	Network diameter	Soft
Storage convolution	No of nodes in the network	Maximum Network diameter
Communication convolution	No of nodes in the network	Double of no of network nodes.
Time convolution	Network diameter	Double of maximum network diameter.
Routing philosophy	Flat	Flat
Loop free	Yes	Yes

Table No:4 Review for Summary of DSDV performance conducted by different researchers

(a) When Load is High and Mobility is Low

	Overhead	Delay	Packet Delivery
Broch et al	Medium	Not Measured	High
Johansson et al	Medium	Low	Not Measured
Perkins et al	Not Measured	Not Measured	Not Measured

(b) When Load is Low and Mobility is also low

	Overhead	Delay	Packet Delivery
Broch et al	Medium	Not Measured	High
Johansson et al	Medium	Low	Not Measured
Perkins et al	Not Measured	Not Measured	Not Measured

© When load is High and Mobility is also High

	Overhead	Delay	Packet Delivery
Broch et al	Medium	Not Measured	Low
Johansson et al	Medium	Medium	Not Measured
Perkins et al	Not Measured	Not Measured	Not Measured

(D) When Load is low and Mobility is High

	Overhead	Delay	Packet Delivery
Broch et al	Medium	Not Measured	Low
Johansson et al	Medium	Low	Not Measured
Perkins et al	Not Measured	Not Measured	Not Measured

Table No:5 Review for Summary of DSDV performance conducted by different researchers

(a) When Load is High and Mobility is Low

	Overhead	Delay	Packet Delivery
Broch et al	Low	Not Measured	High
Johansson et al	High	High	Not Measured
Perkins et al	Not Measured	Low	Medium

(B) When Load is Low and Mobility is also low

	Overhead	Delay	Packet Delivery
Broch et al	Low	Not Measured	High
Johansson et al	Medium	High	Not Measured
Perkins et al	Not Measured	Low	Medium

© When load is High and Mobility is also High

	Overhead	Delay	Packet Delivery
Broch et al	Medium	Not Measured	High
Johansson et al	High	Medium	Not Measured
Perkins et al	Not Measured	High	Low

(D) When Load is low and Mobility is High

	Overhead	Delay	Packet Delivery
Broch et al	Low	Not Measured	High
Johansson et al	Medium	Low	Not Measured
Perkins et al	Not Measured	Low	High

Protocols in ad hoc networks", 7th International conference on EHOC, Cambridge, UK, Feb 2008.

[6] Sampo Naski, "Performance of ad hoc routing protocols: characteristics and Comparison", Helsins University of Technology.

[7] Masoud, Fawaz A.M. Shaar, Said Abu Murad. "Enhanced route re-construction method for associativity based routing protocol for mobile ad hoc NET", Journal of Computer Science, Dec 2006 Issue

[8] Abolhasan, Mehran Wysocki, Tadeusz Lipma. "A new strategy to improve proactive route updates in mobile ad hoc networks.", EURASIP Journal on Wireless Communication, Dec 15 2005 Issue

[9] Kim, Kyu-Han Zhu, Yujie Sivakumar, Raghu. "A receiver-centric transport protocol for mobile hosts with heterogeneous wireless interfaces." Wireless Networks, July 2005 Issue

[10] Tsai, Hua-Wen Chen, Tzung-Shi Chu, Chih-. "An on-demand routing protocol with backtracking for mobile ad hoc networks.", Wireless Personal Communications, August 2006 Issue

[11] Mohammed Ilyas, "The hand book of ad hoc wireless networks", Chapters: 7-20, CRC press, 2003