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Optimizing The Performance Of DSR Routing Protocol For MANET's Determining The Most Significant Factor Using Taguchi Approach

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Abstract:

MANETs are infrastructure-less networks formed by dynamic nodes through wireless medium. Routing in MANETs is a challenging issue. Dynamic Source Routing Protocol (DSR), a reactive routing protocol is adaptable for the mobile nature in wireless medium. In enhancing the throughput of the network using the DSR routing protocol for MANETs Taguchi approach is used. A series of experiments were conducted in Opnet simulator 14.5 for improving the performance of DSR Routing protocol. A set of factors like Broadcast Jitter, Network Size (number of nodes) and Simulation time considered in recognizing the most significant elements by designing a series of experiments with Taguchi Approach. A L_{18} Orthogonal-array(OA) with a mixed-level design for the characters at different levels, were analysed by taguchi approach to an optimum level. The experimental solutions reveals that broadcast jitter is as the most influential element in enhancing the throughput of the network using the DSR protocol in the wireless medium.

Keywords: MANET, DSR, OPNET14.5, Broadcast Jitter, Reactive Protocol

Introduction

Mobile ad hoc networks (MANETs) are infrastructure-less networks designed nodes having mobility with limited resources and bandwidth. They are widely used in a variety of applications due to their adaptability, ease of installation, and low cost.

Due to the lack of infrastructure, mobile nodes communicate using multi-hop protocols. That is, there are no access points or routers prior to the establishment of a MANET. As a result, implementing any type of central administration, such as routing, on MANETs is difficult. Identification of route in the MANETS is a tricky process, especially in high mobility scenarios. Thus, selecting a routing protocol that works in all scenarios is critical.

Literature review

Lubdha M.Bendale, et al[6] demonstrated the taxonomy of the routing protocols and segregated as the re-active, pro-active and hybrid routing protocols. In this context a comparative study is made on the analysis of the protocols.

Anjali Anand, et al[11] mentioned and discussed about the factors inclined to the DSR and contradicting to protocol basing on the functionalities

Muhammad Hisyam Lee, et al[9] mentioned the purpose of anaysis of DSR performance using Taguchi approach. The study said that among the considered factors like terrain-size, pause-time velocity of the nodes, size of the network basing on the terrain has most impact on the performance analysis of drop rates for DSR protocol.

Dandan Ding, et al[12] mentioned the characteristics and applications of Ad Hoc networks protocols AODV and DSR. Also mentioned the comparative analysis of both the protocols using OPNET simulator basing on their QoS metrics.

Prathviraj N, et al[3] mentioned that routing protocol designs and quantity parameters like mobility, nodes, transmission-range, throughput, traffic load and end-to-end delay can have performance variation in DSR routing protocol. Also mentioned that Taguchi method is powerful approach to identify the effective components that is responsible for efficient performance of DSR protocol in MANETS.

P.Srikanth, et al[5] specifies that a set of experiments were conducted on cooja simulator to improve QoS metrics of the RPL protocol. These experiments are supervised to a maximum level using the taguchi approach. The experimental outcomes clearly signifies that ICMP is highly influencing among the ICMP intervals, Size of the network, transmission-range and topology in amplifying the QoS Metrics

P.M. Manohar, et al[7] Specifies that Route-Request-Wait-Time (RRWT) as the critical factors among the other in boosting the QoS measures of DYMO protocol for routing in different network sizes (i.e smaller and medium)

Routing protocols Claasification in MANETs

Most of the mobile ad hoc networks having the topology with multi hop nature changes the dynamics of any networks due mobile nature. Establishment of connection for all the node in the network is a challenging concern due the mobility in the networks. The Fig 1 Clearly illustrates the taxonomy of the Routing Protocols

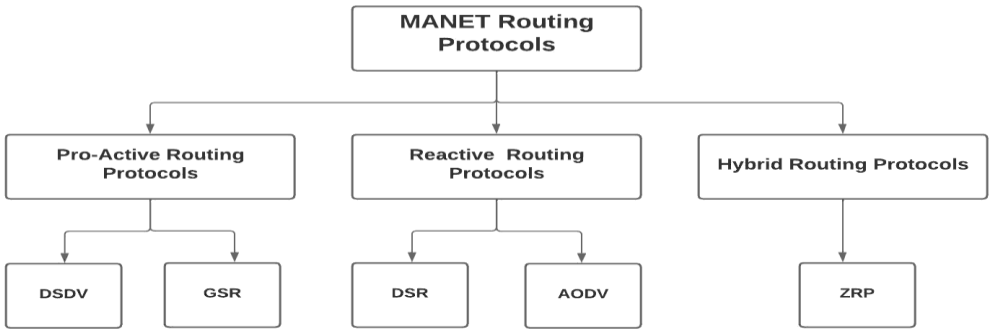

Fig-1 Taxonomy of the protocols for routing in MANETs

Pro-active Protocols

Table-driven routing protocols are another name for proactive routing systems. Each mobile node has its own routing table, which contains information about all possible destinations' paths. Because of the mobility of the nodes and changes in topology, these routing tables are updated and maintained on a regular basis. Proactive routing protocols such as OLSR and DSDV are examples.

Re-active Protocols

On Demand routing protocols used for routing are known as re-active protocols. A dynamic updating of routing route-tables needs to be maintained a specific route is not available. A communication link needs to be established between the nodes dynamically (from source to destination basing on the demand). These reactive routing algorithms properly capture the characteristics of a more dynamic ad-hoc network. AODV, TORA and DSR are instances of re-active protocols.

Hybrid protocols

Hybrid protocol is amalgam of techniques from the Re-active and Pro-active. Hybrid protocols will optimize the beneficial outcomes re-active in smaller networks (in reducing the time) and pro-active in larger networks (in minimizing the control overhead). ZRP is ideal protocols for hybrid.

Specifically, Because of the high overhead and energy consumption of proactive routing protocols, they are not suitable for wireless communication. Because they have less overhead and use less energy, reactive routing protocols are ideal. The intermediate node in DSR (Dynamic Source Routing) is responsible for minimising route discovery time, thus efficiency is enhanced based on delay.

Dynamic Source Routing protocol (DSR)

In contrast to proactive routing protocols that use route tables, Dynamic Source Routing (DSR) [1,2] is an example of an on-demand routing protocol that uses the idea of source routing. To locate and maintain routes, DSR employs Route Discovery and Route Maintenance techniques. Their primary functions are described below.

Route Discovery in DSR

The Route Discovery process initiates from the source node by broadcasting a local packet specified as the ROUTE-REQUEST (R-REQ) to all nodes the neighbouring to it within vicinity range of the wireless connecting medium. R-REQ message initiates the route discovery process between the source and destination. R-REQ consisting of distinctive Request-id by the request initiator, the initiator node of the R-REQ consisting of empty list. The subsequent nodes between the initiator and the destination nodes maintains a copy from where the R-REQ has been routed. ROUTE-REPLY(R-REP) message has been sent back to initiator node in process of Route Discovery. Initiator node caches it and maintains a copy or else discards the packet if already received form the earliest. If not node adds the address to itself to the ROUTE-REQUEST and broadcasts to the neighbour node retaining the distinguished ID it had obtained.

Route Maintenance in DSR

The method through which a source node governs if the topology of the network had already transformed toward the point where it can no longer just use path to a destination host since a connection along the route is damaged while using a source route to the destination node is recognized as route maintenance. When Route Maintenance reports that what a source route is damaged, the source node can try any other route to the destination node or rerun Route Discovery to find a new route.

Research Methodologies

Research methodologies basically comprises Qualitative and Quantative Research

Qualitative Research Methodologies

Simulation, Mathematical, and Experimental methodologies have been used in qualitative research. Because the experimental procedure emphasizes on feasible issues and the mathematical procedure is rigid, simulation procedure is used in OPNET simulator with DSR routing protocol in the wireless medium. In the research analysis gathering all the data and determing the essential factor for having the significant importance on the throughput of DSR routing protocol.

Quantitative Research Methodologies

In the Quanatative Research methodologies identifying the essential factors in the DSR routing protocol in maximizing the throughput for enhancing the performance. A quite series of experiments were conducted and analyzed by using the taguchi methodology using the principle of optimality. In the series of experiments three factors like Broadcast Jitter, Simulation time and network size were considered up to the 4 level in recognizing the essential factor.

Simulator Used

The Optimized Network Engineering Tool (OPNET) is a program that may be used to simulate the behavior and performance of any network. OPNET 14.5 is one of the most capable research-

oriented network simulation tools available, offering a development environment for modelling and simulation of deployed wired and wireless communication systems. The simulation scenario of OPENET environment is shown in the Fig 2

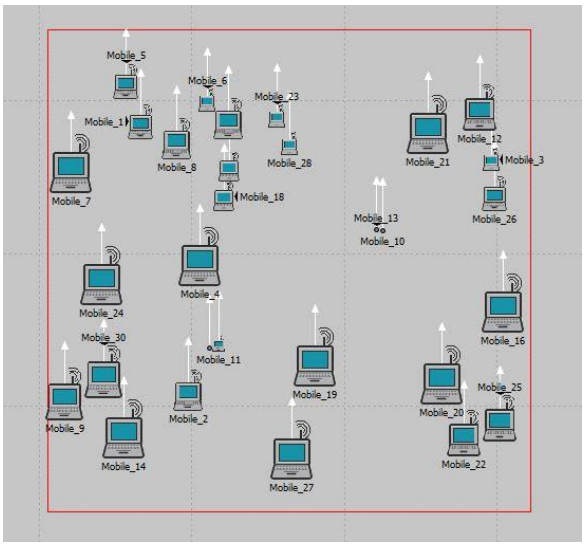

Fig-2 Simulation Scenario in OPNET Environment

- For the existing approaches, a different set of models can be developed.
- Comparative Study of existing proto type models and new models for the various existing protocols.
- A relatively new prototypes models can be incorporated in real world scenarios.
- Analysing the performance of the various QoS Metrics.

Simulation Setup:

The Simulation setup for simulating the DSR routing protocol in OPNET environment is shown below in Table

Simulation Parameter

Routing Protocol	DSR
Simulation Time	300 sec.
Simulation Area	1000 X 1000m
Traffic Type	Exponential
Node Type	MANET
Packet Size	1024 bytes
Speed	15 m/sec
Network size	30
Transmission Range	250m

Receiver Range	250m
Min. & Max speed	0 m/s & 12 m/s
Pause time	0 m/s
Mobility Model	Random way Point
Node Placement Model	Random
Broadcast Jitter(seconds)	0.01, 0.009, 0.008, 0.007, 0.006,0.005, 0.004, 0.003, 0.002,0.001,0
Address mode	IPV4

Table-1 Simulation Parameters

Here in this paper analyzing the importance in improving the throughput of DSR routing protocol for MANET's. The factors like Network Size, Simulation-time and broadcast Jitter analyzing throughput for DSR Protocol.

Findings and Analysis

Here we are using the OPNET Simulator, Simulated the DSR Protocol in the various scenarios by modifying the various parameters in recognizing the essential component is shown in Fig-3

Fig-3 Taguchi Approach

Flow Diagram

Flow Diagram illustrates the steps involved in the determing the optimal function, orthogonal array to requirement specification for design of the experiments. Identifying the significant factor with respect to the signal-to-noise ratio. The Flow Diagram is shown in Fig-4

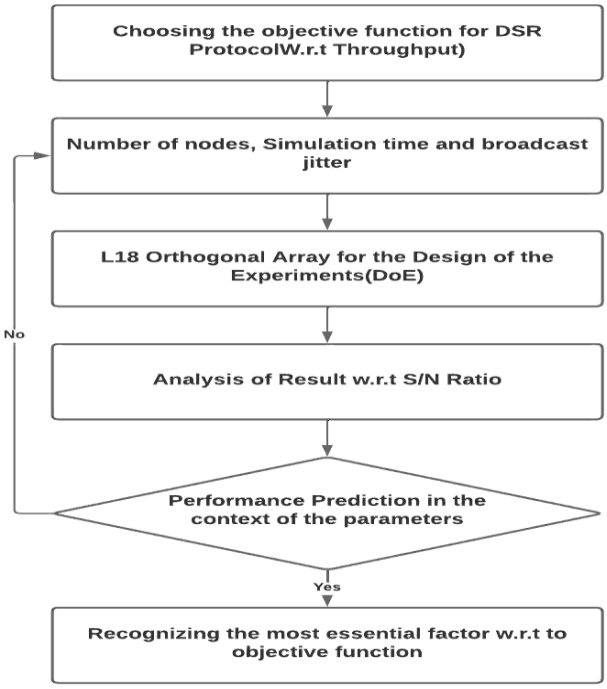

Fig-4 Schematic for the Taguchi Method to DSR Routing Protocol

Orthogonal-Array (L_{18})

An L_{18} Orthogonal Array with an mixed level approach is used for recognizing the essential factor. A Mixed level Design of the factors Broadcast jitter(6 Levels), Number of the nodes(3 Levels) and Simulation time(3 Levels). The factor wise description of factors is shown in the Tab 2

S.No	Factors	Level-1	Level-2	Level-3	Level-4	Level-5	Level-6
1	**Broadcast Jitter in Second**	1(0.01)	2(0.009)	3(0.007)	4(0.005)	5(0.003)	6(0.001)
2	**Nodes**	20	30	40	*	*	*
3	**Simulation time(min)**	5	10	15	*	*	*

Table-2 Factor Wise up to different Levels

An L_{18} Orthogonal Array with detail description of the parameter like nodes, simulation time and broadcast jitter with respect to throughput. The L_{18} Orthogonal Array is shown in Tab 3

JITTER	NODES	SIMULATIO TIME	THROUGHPUUT
1	30	5	80152.1234
1	40	10	81473.5674

1	50	15	81975.4567
2	30	5	82978.4799
2	40	10	83104.6
2	50	15	83897.547
3	30	10	85796.7897
3	40	15	85987.2349
3	50	5	94856.2314
4	30	15	95786.479
4	40	5	96781.2567
4	50	10	95781.1254
5	30	10	100789.256
5	40	15	101897.56
5	50	5	100256.3247
6	30	15	113456.7894
6	40	5	109567.256
6	50	10	112356.78

Table-3 L_{18} Orthogonal Array

The Orthogonal Array with respect to C4 Column is analyzed by the taguchi approach with respect the DoE in recognizing the essential factor w.r.t to signal-to-noise ratio and means for the Throughput.

Throughput

Throughput of a network specifies the number Bits/Bytes delivered from source to destination in a second

Throughput = No of Bits/Bytes delivered / Second (bits or bytes per sec)

To improve the performance of MANETs the network-transfer capacity needs to be improved. The performance optimization of MANET can be through improving efficiency of the throughput. So we consider the “Larger is the Better” is shown in the Tab 4

Level	JITTER	NODES	SIMULATION TIME
1	98.19	99.32	99.42
2	98.42	99.33	99.33
3	98.97	99.49	99.39
4	99.66		

5	100.08		
6	100.97		
Delta	2.78	0.17	0.09
Rank	1	2	3

Table-4 Response-Table w.r.t S-N-Ratio

The most significant element is identified in Table 4's response table. The highly essential element of the Response-table is the value of delta with the minimum rank. It is observed from the above values that Jitter is the key element in enhancing the QoS Metrics

Delta: Delta is the dissimilarity between the signal-to-noise ratio's maximum and minimum averages.

The Response table also identifies the Broadcast jitter as the most essential factor in enhancing the throughput of the DSR routing protocol for MANET's. The Broadcast jitter is having the rank 1.

Signal to noise Ratio main affect plots

In Fig-5, the main effect plot for signal-to-noise ratio pictorially visualises the highly relevant element.

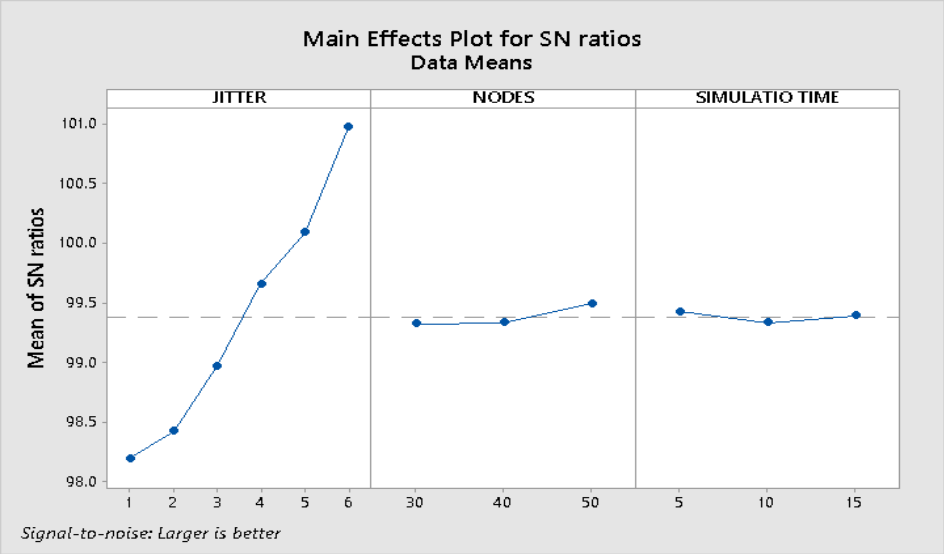

Fig-5 Main affect Plots of the Signal-to-Noise Ratio

The main affect of Signal-to-noise ratio also obviously identifies the Broadcast jitter as the most essential factor in enhancing the throughput of DSR Protocol in MANET's.

Outcomes and Future Improvements

From this research, a series of experiments were conducted to an optimal level using the taguchi method to determine the best element influencing the DSR Protocol in optimizing the Network's Throughput. The experimental results shows that jitter is the most important component in terms of throughput among the three factors of jitter, number of nodes, and simulation time. Because DSR is a Reactive Routing Protocol for MANETs, the main limitation is to maximize the network's throughput. As a result of this contrast, the broadcast jitter is the most important component in increasing the DSR Protocol's throughput.

A Soft computing techniques like fuzzy or ANFIS are implemented to convert static value of the broadcast jitter to a variable value which adapts to the realworld network conditions.

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