Analysis of routing protocol metrics in MANET

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***Abstract*— This research paper work is about the analysis of routing protocol metrics in MANET. The routing protocols metrics are important subject matter in the mobile Adhoc network environment. The MANET environment connecting devices or nodes with each other energetically and develop mobile Adhoc wireless network . It offers the mobility to network devices to freely move in any direction and develop connection to any device. The aim of this research paper is to analyze the routing protocol metrics as, radio range, delay, load, media access delay and throughput by evaluating the simulation of AODV, DSR and TORA routing protocols using video conferencing application. The simulation results have been carried out through OPNET 14.5 modeler tool, however scenarios created, having different node densities and different WLAN physical characteristics and routing protocol metrics and analyzed results.**

Keywords-- Manet; Routing; Protocol; Metrics; Opnet

I. INTRODUCTION

The MANET (Mobile Adhoc Network) is the flavor of wireless mobile network. Wireless mobile networks played an important role in the field of communication and technology. The MANET is described as it is auto configured network layout in that condition where fixed network could not be deployed. In MANET all devices develops auto configuration links and establish the network. In Mobile Adhoc network each device is freely move independently. The MANET have features of self-organizing, automatic dynamic configuration and as well self-administration [1]. The MANET network have AODV, DSR, TORA, OLSR and ZRP routing protocols. But in this independent study AODV, DSR and TORA routing protocol have been considered for analysis.

II. PROBLEM STATEMENT

There are many issues, problems in the Mobile Adhoc Network; likewise there is Mobility issue when devices are moved independently. There is also scalability issue in MANET as well there is security issue, we know that in wireless technology there are many flaws, in security the security protocols are vulnerable hence that affects mobility scalability and performance of overall MANET network. Obviously there is also routing protocol issues which affecting the services of MANET. Nodes connectivity issues which degrades the services of MANET. This problem occurs due to routing protocols which providing the link between nodes which are AODV, DSR, TORA, OLSR and ZRP. Hence in this

study routing protocol AODV, DSR and TORA metrics, media access delay, network load, end to end delay, throughput, transmission range and transmit power analyzed through simulation

III. RELATED WORK

Mobile Adhoc network is wireless network technology which is more feasible for that Location where it is difficult to deploy the fixed network. Hence it provides the dynamic infrastructure by which self configured network can be deployed dynamically [3]. M.L Sharma et al has worked on proactive AODV and reactive DSR routing protocols evaluated using FTP traffic by using separate scenarios and observed the results which were varied according to traffic and the simulation results that the reactive DSR routing protocol performs better as compared to the proactive AODV routing protocol in terms of different traffic parameters. On other hand proactive routing protocols is have good performance in the sense of end to end delay and in the sense of routing message overhead[4] . Other author Jahangir khan et al have evaluated QoS framework and observed the packet delivery issues between intermediate nodes [5]. Also Mashri et al evaluated in their research the time of packet delivery is varied and OLSR is weak routing protocol [6]. Singla et al compared the AODV, TORA and DSDV routing protocols both TCP & CBR traffic pattern. In terms of packet delivery ratio and average end to end delay AODV is better than DSDV [7]

In MANET there are two categorize of routing protocols. One is on- demand routing protocols category and another is table driven routing protocols category[2]. Here on-demand routing protocol discussed. AODV (Ad hoc On demand Distance Vector) it is known as on demand routing protocol which mean routes are established when required. [3,8]. DSR (Dynamic Source Routing)It is known as reactive protocol having two mechanisms one is route discovery and an others is maintenance of source routes. In Route discovery, source node obtain a route towards destination node. In route maintenance, the mechanism by which source node detect route when network topology changed. It is not used longer that route to a destination node.[3,8]. TORA (Temporally Ordered Routing Algorithm) It is known as reactive protocol. It is loop free and uses distributed routing algorithm. This protocol has three functions 1) Creating routes: Source node to destination node has required to establish direct links from source to destination which accomplished by using query and reply process through which DAG directed acyclic graph established. 2) Maintaining routes: Routes are maintained by response of topological change by reestablishing the route. 3) Erasing routes: CLR clear packets used for to erase the routes[3,8]

IV. METRICS

L. Transmission Range

Transmission range is an important metric which are used in this paper study. We have the value of transmit power (watt) in OPNET modeler 14.5. By using the attribute of

transmit power we can determine the transmission range by the following formula:

$$P = \left(\frac{4\pi D}{0.12476}\right)^2 * 10^{-12.5}$$

There is default value of power which is = 0.005 watt, Now the formula is drawn by using power attribute and Pi value 3.14159. this has been drawn through excel and the transmission range found:

=POWER((4*3.14*B1/0.12476),2)*POWER(10,-12.5)

Transmission range formula drawn in excel.

Table 1: The following transmission ranges has been calculated by using above formula

Transmit Power (w)	Transmission Range(m)
3.20825E-05	100
0.00012833	200
0.000288743	300
0.00051332	400
0.000802063	500
0.00115497	600
0.001572043	700
0.00205328	800
0.002598683	900
0.00320825	1000
0.003881983	1100
0.004619881	1200
0.005421943	1300
0.006288171	1400

M. Transmit Power

This is an attribute of Wireless LAN which can be changed for increasing the Transmission range its default value increased it has been observed by solving the wireless transmitting range formula that as increased the power value the transmission range increased. It means it directly impact on the MANET protocol performance.

N. Media Access Delay

Media Access Delay is due to the congestion of network[16]

O. Network Load

The network load corresponds to total number of bps assigned to WLAN layers for higher layers to all nodes of WLAN in the network [15]

P. End to End Delay

The average time that packet acquired in transit from one end to another end is known as Packet end to end delay. It is a measure which shows the reliability of the routing protocols which are using all constraints of the MANET[15]

Q. Throughput

The ratio of data amount reaches from source to destination with respect of time taken the destination received last packet that referred to throughput[9]. The throughput can be expressed in bps or packets per second. The phenomenon of topology change frequently affect this metric in MANET [9]. It has been analyzed in different MANET wireless environment with different metrics.

V. RESEARCH METHODOLOGY

The methodology or proposed approach which has been carried out for this research paper study of analysis of MANET networks routing protocol metrics the OPNET tool is used. In this paper, it has been studied out by evaluating the MANET routing protocols using event driven protocols which are AODV, DSR, and TORA by using video conferencing application traffic. To accomplish this task opnet 14.5 modelor used and, media access delay, network load, end to end delay, throughput, transmission range and transmit power metrics analyzed and observed the results, how these metrics affecting the behavior of routing protocols in MANET.

VI. SIMULATION EXPERIMENTS

The study is carried out in this research papery by developing the 4 scenarios having 12, 16 20 and 24 nodes. The routing protocol AODV, DSR and TORA has been configured in each scenario with default setting. Then Wireless LAN standard 802.11a, physical characteristics are used first, by using default setting attributes configuration the simulation has been carried out and observed the results. Then changed the Wireless LAN standard 802.11a to Wireless LAN Standard 802.11g physical characteristics and same way, by using default setting attributes configuration, the simulation carried out and observed the results.

On other hand the Wireless LAN attribute transmit power (w) has been changed from default setting 0.005 w to 0.004 w and by above process simulation carried out and observed the results of routing protocol metrics which shows how results affected by changing the transmit power. Indeed it has been seen how performance of MANET degraded.

There are 4 scenario designed having 12, 16, 20 and 24 nodes developed for simulation according to given tabular metrics. But here only one scenario having 16 nodes discussed. However 4 scenarios having 12, 16, 20, and 24 nodes simulation results analysis in VII SECTION also given in this paper In the above scenarios 1,2,3,4, 1500x1500 meters MANET campus network has been designed.

From object palette of MANET the application definition, profile definition, mobility configuration, Fixed server and mobile nodes dragged and dropped to workplace. After that the application definition configured, firstly name has been changed then in the application attribute video conferencing application configured with high resolution description.

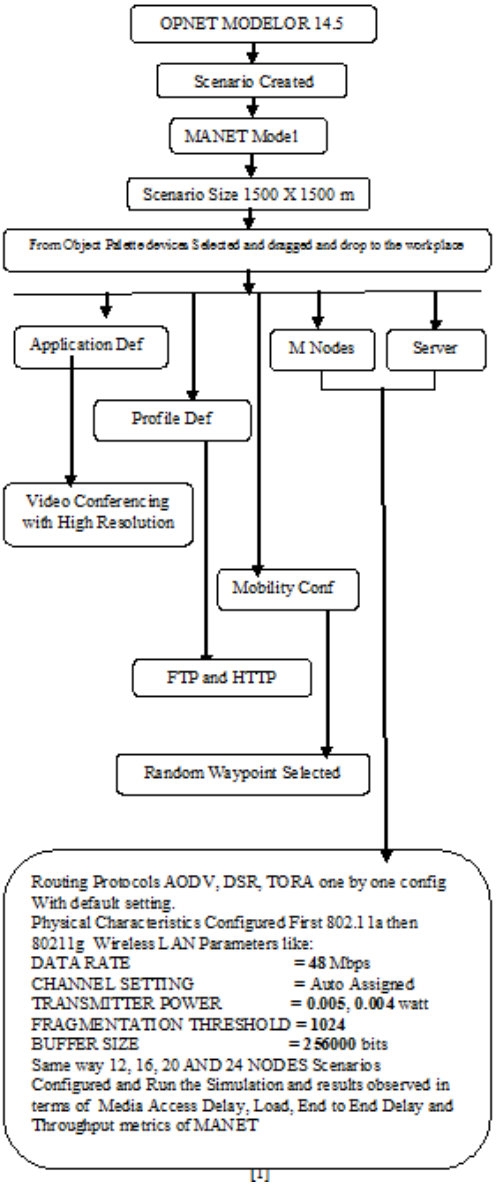

Fig. 1. Flowchart

Table 2: Main characteristics of the scenarios

Scenarios Parameters	Scenario Values
Simulation tool	OPNET 14.5 Version
MANET Protocols	AODV, DSR, TORA
Campus Network Scenario Size	1500x1500 meters
Number of Mobile Nodes	12, 16, 20 and 24
Data Rate	48 Mbps
Application Name	Video Conferencing
Application Description	High Resolution
Wireless LAN Phy Characteristics	802.11a and 802.11g
Network Protocol	IP
Mobility model	Random Waypoint
Scenario Simulation Time	30 min

Table 3: Wireless LAN parameters values

Wireless LAN Parameters	Wireless LAN Parameters Values
Channel Setting	Auto assigned
Transmitter Power	0.005, 0.004 Watt
Transmission Range	1250, 1117 meters
Fragmentation Threshold	1024 bytes
Buffer Size	256000 bits
Mobile Node Speed	10 m/s

Table 4: Routing Protocol Metrics

Wireless LAN Parameters	Wireless LAN Parameters Values
Channel Setting	Auto assigned
Transmitter Power	0.005, 0.004 Watt
Transmission Range	1250, 1117 meters
Fragmentation Threshold	1024 bytes
Buffer Size	256000 bits
Mobile Node Speed	10 m/s

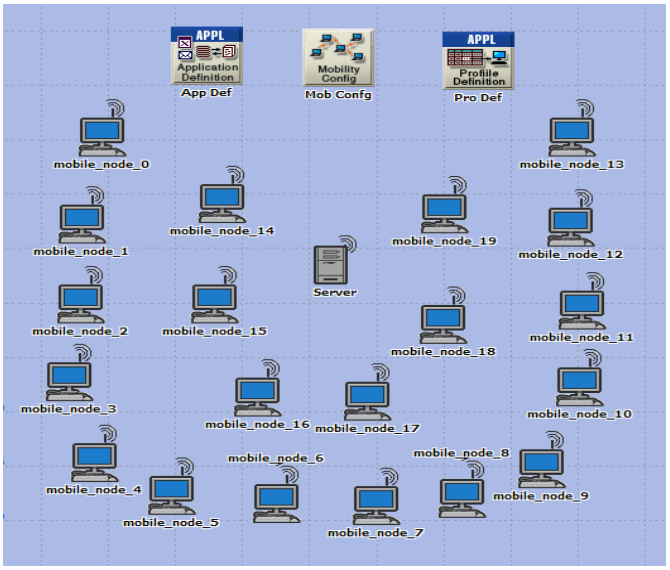

Fig. 2. Scenario 2 with WLAN 802.11a/ 802.11g having 16 Nodes

Profile Definition also configured firstly the name has been updated then profile name configured by services FTP and HTTP and application video conferencing configured. The mobility configuration also configured, first name updated then the random waypoint configured. The server also configured first name updated then the MANET protocols AODV, DSR and TORA configured with default setting. Then server application support profile updated and supported services updated then Wireless LAN parameters configured.

The physical characteristics configured as WLAN 802.11 than after its simulation again the physical characteristic of WLAN 802.11g configured with same parameters having, data rate configured 48 mbps, channel setting auto assigned, transmitter power 0.005 watt, fragmentation threshold 1024 and buffer size 256000 bits configured.

The simulation time of the above scenario is 30 minutes. Same way 12, 16,20 and 24 nodes configured separately. Then simulation carried out and observed the results of routing protocol metrics. Here only scenario 2 discussed.

Again after completion of simulation 4 scenarios the transmit power attribute reconfigured from 0.005 watt to 0.004 watt for comparative analysis how transmit power affecting the routing protocols of MANET. All above steps repeated.

In the above Fig. 1 Scenario. 2 it has been configured 802.11a and evaluated the results. After that 802.11g configured evaluated the results. The transmit power 0.005 w for both WLAN's environment.

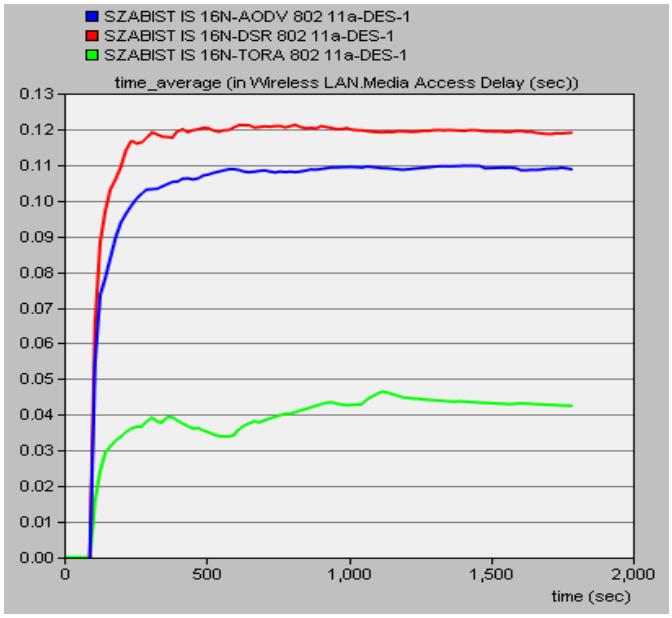

Fig. 3. Wireless LAN (802.11a) media access delay

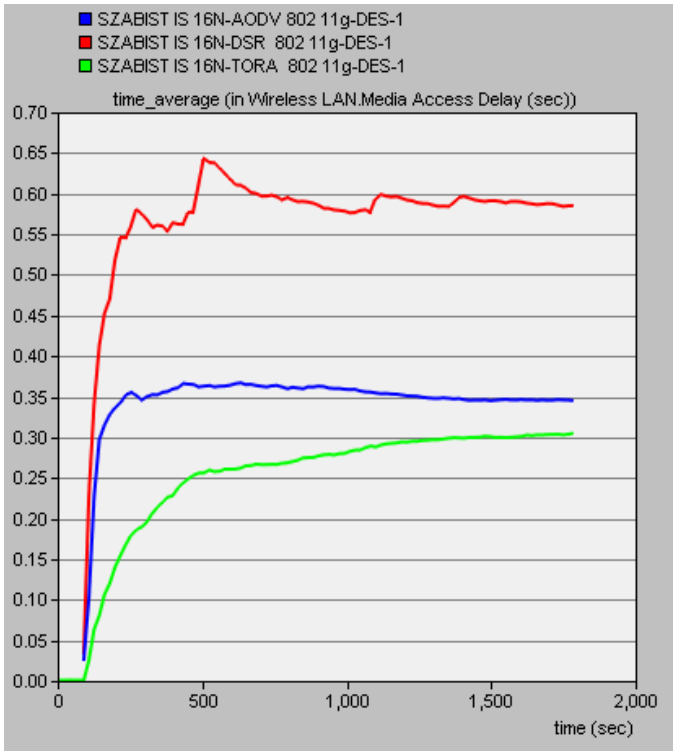

Fig. 4. Wireless LAN (802.11g) media access delay

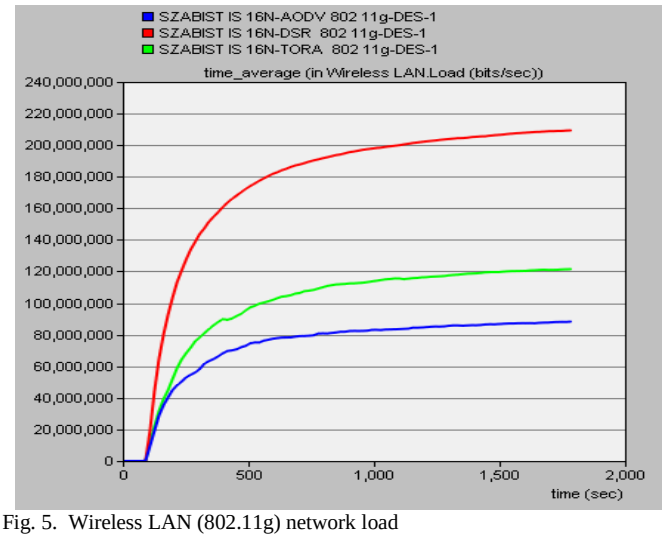

Fig. 5. Wireless LAN (802.11g) network load

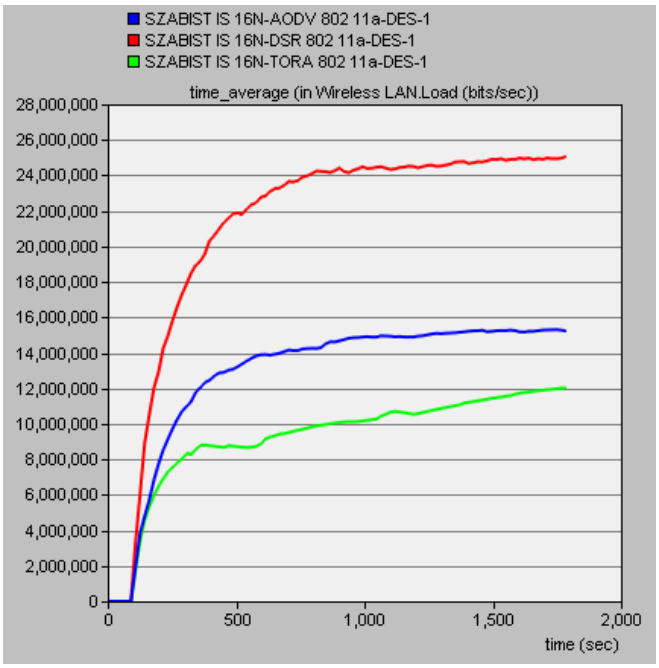

Fig. 6. Wireless LAN (802.11a) network load

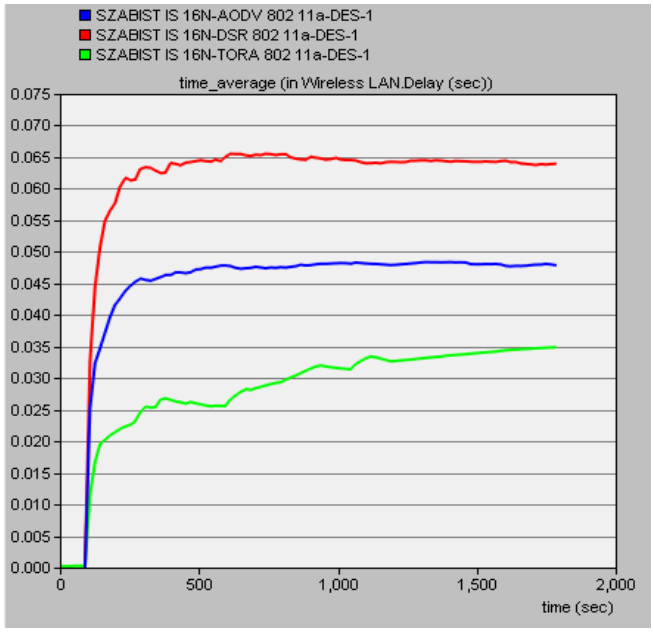

Fig. 7. Wireless LAN (802.11a) end to end delay

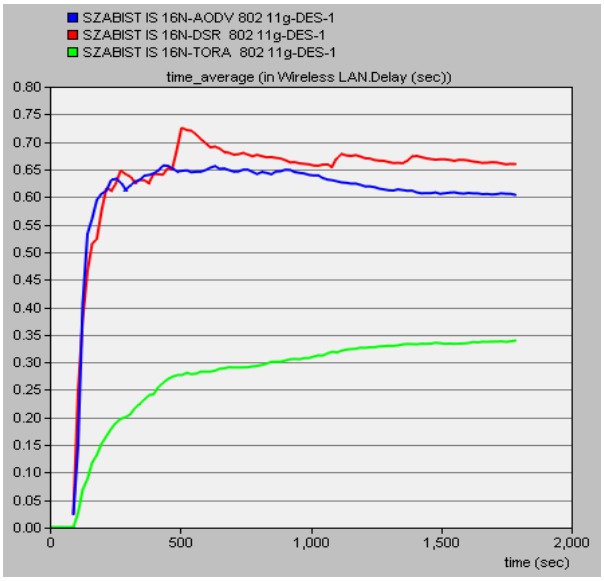

Fig. 8. Wireless LAN (802.11g) end to end delay

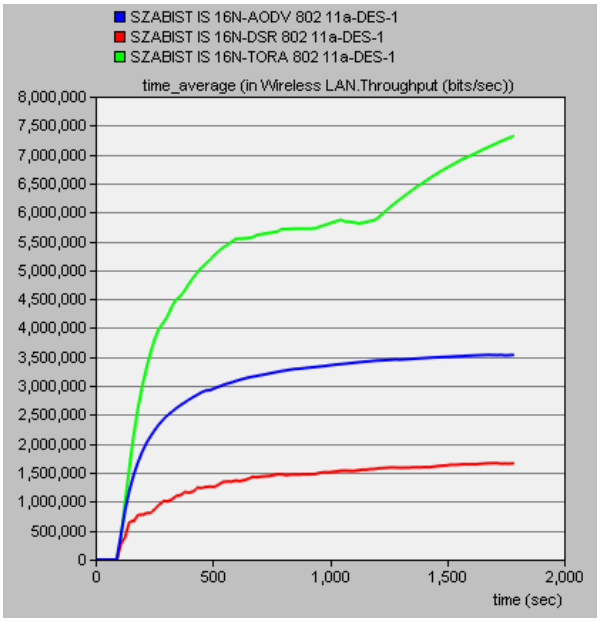

Fig. 9. Wireless LAN (802.11a) throughput

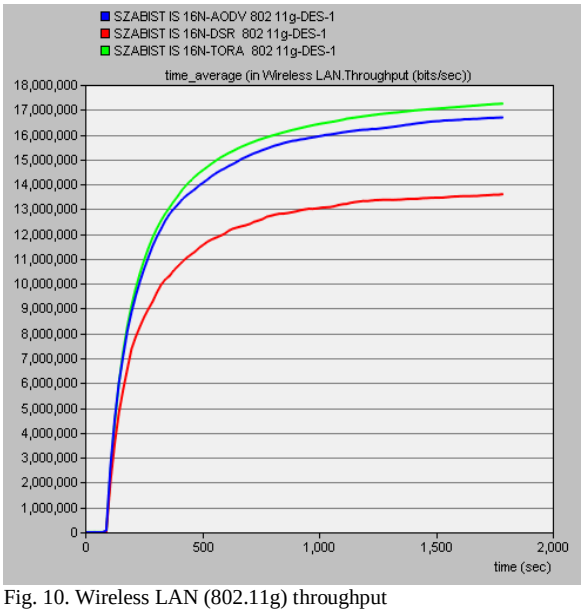

Fig. 10. Wireless LAN (802.11g) throughput

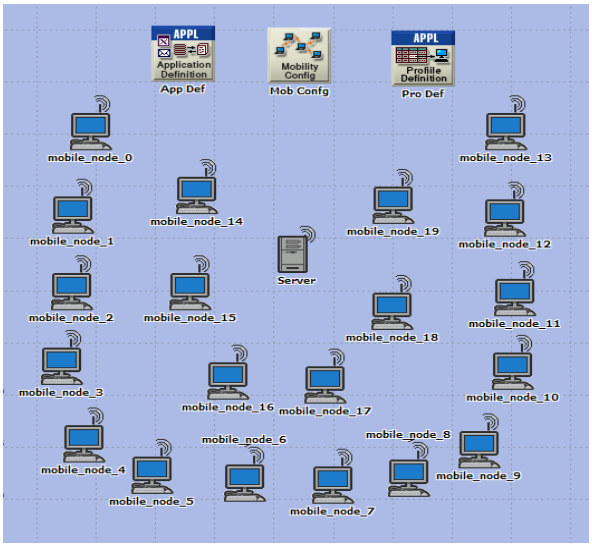

Fig. 11. Scenario 2 with WLAN 802.11a/ 802.11g having 16 Nodes

In the above figure, Scenario. 2 , 802.11 transmit power value changed from 0.005 w to 0.004 w for analysis of routing protocol behavior how affect the metrics in MANET.

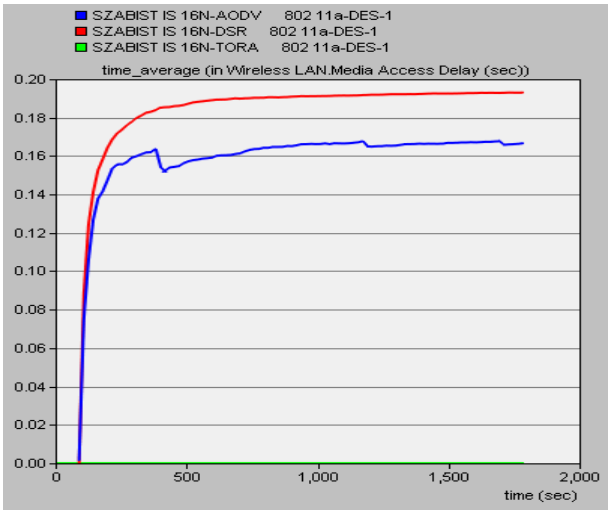

Fig. 12. Wireless LAN (802.11a) media access delay

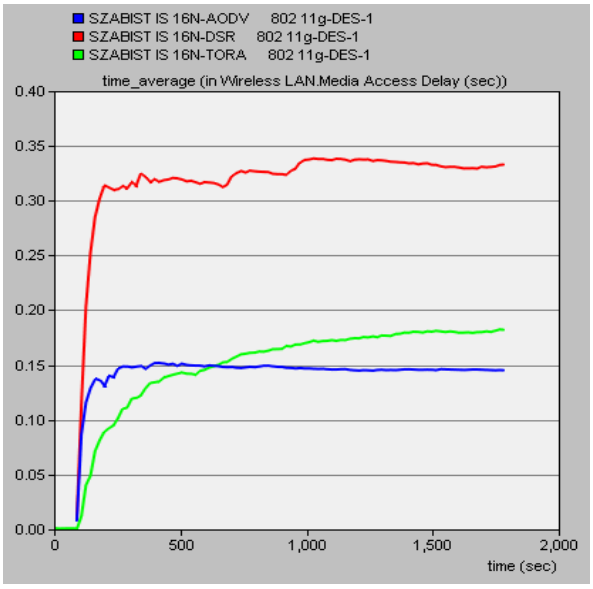

Fig. 13. Wireless LAN (802.11g) media access delay

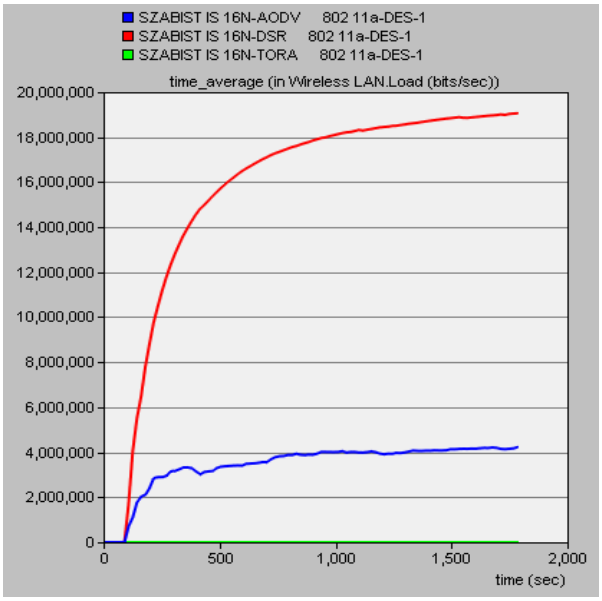

Fig. 14. Wireless LAN (802.11a) network load

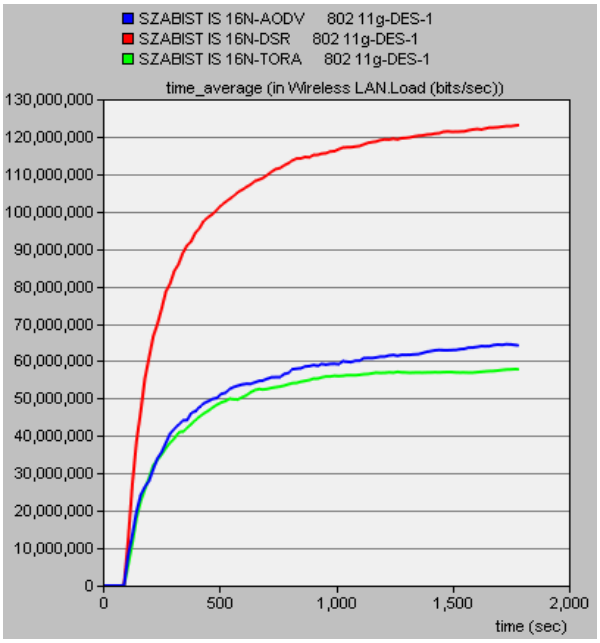

Fig. 15. Wireless LAN (802.11g) network load

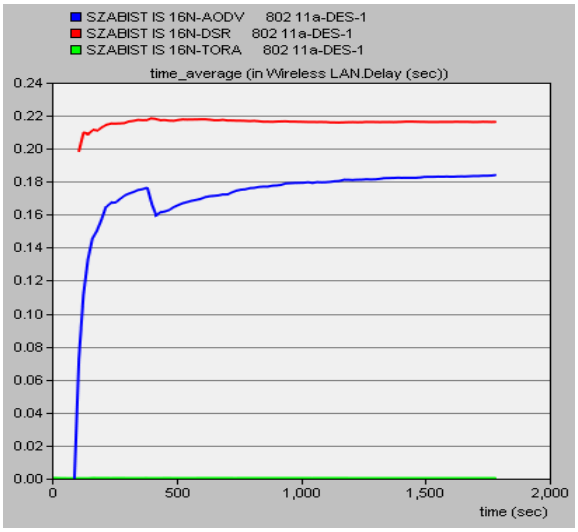

Fig. 16. Wireless LAN (802.11a) end to end delay

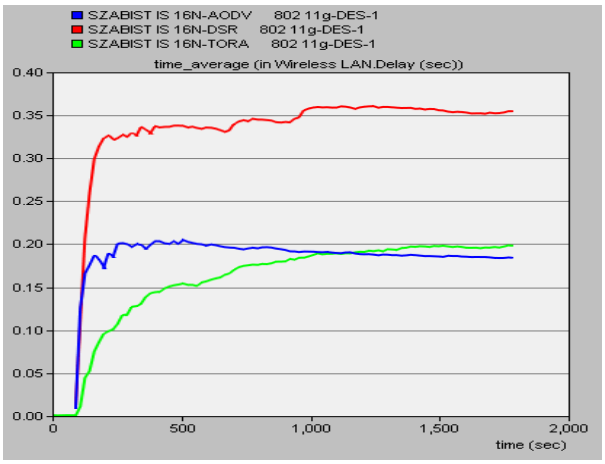

Fig. 17. Wireless LAN (802.11g) end to end delay

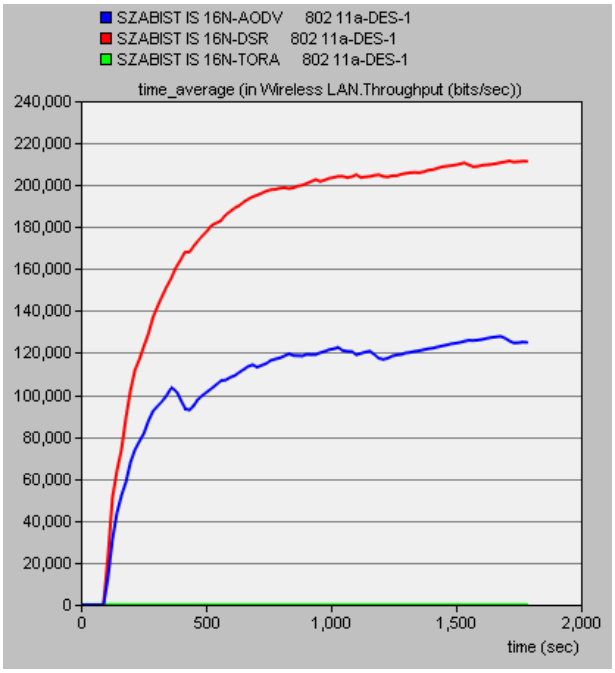

Fig. 18. Wireless LAN(802.11a) throughput

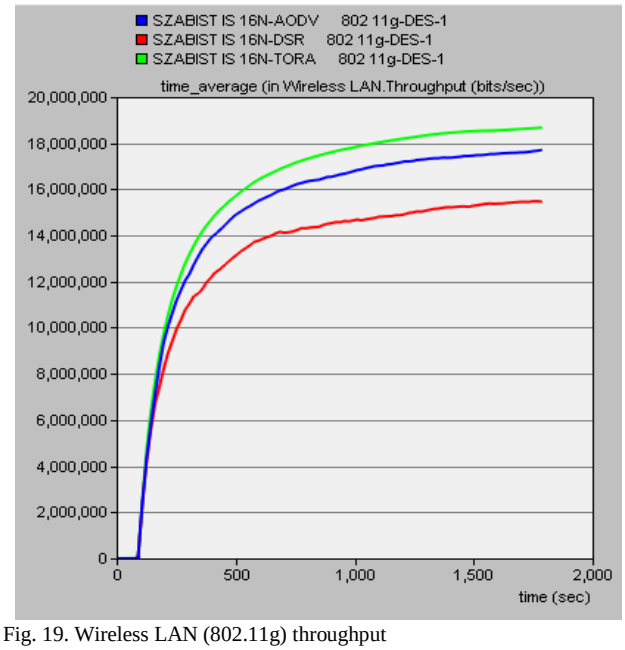

Fig. 19. Wireless LAN (802.11g) throughput

VII. SIMULATION RESULTS

Table 4: Scenario1, scenario 2, scenario 3 and scenario 4 results observations

	Scenario 1 (12 -Node)			W LAN 802.11a			WLAN 802.11g		
Metrics	Node Density	Transmit Power (w)	Transmission Range	AODV	DSR	TORA	AODV	DSR	TORA
WLAN Media Access Delay	12	0.005 (W)	1250 (m)	0.04 Sec	0.096 Sec	0.045 Sec	0.187	0.265 Sec	0.09 Sec
WLAN Load				15.0 Mbps	60.1 Mbps	35.0 Mbps	75.0 Mbps	131 Mbps	50.0 Mbps
WLAN Delay				0.045 Sec	0.080 Sec	0.042 Mbps	19.5 Sec	0.25 Sec	0.93 Sec
WLAN Throughput				10.2 Mbps	9.0 Mbps	13.6 Mbps	12.5 Mbps	12.8 Mbps	16.2 Mbps
WLAN Media Access Delay	12	0.004 (W)	1117 (m)	0.17 Sec	0.15 Sec	0.0001 Sec	0.10 Sec	0.156 Sec	0.12 Sec
WLAN Load				5.4 Mbps	8.4 Mbps	0.002 MBPS	52 Mbps	86.3 Mbps	45 Mbps
WLAN Delay				0.183 Sec	0.156 Sec	0.0003 Sec	0.12 Sec	0.173 Sec	13 Mbps
WLAN Throughput				0.42 Mbps	0.22 Mbps	0.0002 Mbps	19.3 Mbps	18.24 Mbps	19.29 Mbps

	Scenario 2 (16 -Node)			W LAN 802.11a			WLAN 802.11g		
Metrics	Node Density	Transmit Power (w)	Transmission Range	AODV	DSR	TORA	AODV	DSR	TORA
WLAN Media Access Delay	16	0.005 (W)	1250 (m)	0.11 Sec	0.12 Sec	0.042 Sc	0.35 Sec	0.59 Sec	0.30 Sec
WLAN Load				15.2 Mbps	25 Mbps	12 Mbps	88 Mbps	209 Mbps	121 Mbps
WLAN Delay				0.048 Sec	0.064 Sec	0.043 Sec	0.60 Sec	0.66 Sec	0.34 Sec
WLAN Throughput				3.5 Mbps	1.7 Mbps	7.3 Mbps	16.6 Mbps	13.6 Mbps	17.23 Mbps
WLAN Media Access Delay	16	0.004 (W)	1117 (m)	0.17 Sec	0.193 Sec	0.0000 Sec	0.15 Sec	0.33 Sec	0.18 Sec

CONCLUSION

This research paper providing analytical study of Mobile Adhoc Network about the routing protocol metric behavior when the power attribute value changed, the behavior of routing protocol performance are increased or decreased means changed. It has been observed from results that transmit power has directly impact on the performance of routing

protocol metrics. Same way transmission range also affecting the routing protocol performance and metrics became affected. In this paper study transmit power affecting overall MANET routing protocol functionality, it has been analyzed. The physical characteristics 802.11a or 802.11g are analyzed separately by using different metrics for routing protocols, it has been observed AODV, DSR and TORA is not working properly in 802.11a environment when transmit power value decreased from 0.005 to 0.004. it means by decreasing power also metrics performance of routing protocol in 802.11g environment also affected it has been observed in this paper.

FUTURE WORK

There are so many issues in the architecture of mobile adhoc network, the areas which can be focused are the power issue, scalability issue, mobility issue, security issue, changing of the routing protocol algorithms for ensuring the performance of MANET. These are the wide areas which can be considered for improvement of MANET

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