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Research Article

Comparative Analysis of Wired and Wireless Protocols using OPNET

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Abstract

This paper attempts to analyze the performance of wired (RIP, OSPF and EIGRP) and wireless (AODV, DSR, OLSR) protocols to experience better performance in network services such as FTP and Video Conferencing and use them for open source model architecture which could be used to auto assist the vehicle to its destination. The performance of these routing protocols is evaluated with respect to network delay, throughput and CPU utilization, FTP download and uploads response time, packet end to end delay and a detailed simulation study is performed on the network with different routing protocols. Here in wired protocols, a comparison is done with weighted-faired queuing (WFQ) technique on different scenarios taking into consideration the users, services, and locations of the hosts and results shows that EIGRP is the best one in the network in all the parameters i.e. Delay, Throughput and CPU utilization, Video Conferencing service and after that OSPF will be the best choice. In wireless protocols, we simulate a Mobile ad hoc network with all nodes in the network receiving FTP and Video traffic from a common source (wireless LAN server). In addition, the mobile nodes were randomly placed in the network to provide the possibility of multihop routes from a node to the server. From this study, result shows that for delay either AODV or OLSR will be the best choice but if we consider delay with throughput then AODV will be the best choice compare to OLSR and DSR and if we consider CPU utilization along with delay and throughput, Video conferencing service then also AODV is the best in network but for FTP, DSR and OLSR will be the best choice.

Keywords: *Wired protocols, Wireless Protocols, FTP, Video Conferencing, Delay, Throughput, CPU Utilization and weighted faired queuing*

1. Introduction

Routing protocols are used to determine the shortest path to the destination. Information on network is delivered using routing protocols but knowledge for selection of right protocol is must to experience better performance on network services like VOIP, Video Conferencing, HTTP and FTP. The dynamic routing protocols like RIP, OSPF, and EIGRP keeps track of paths using routing algorithms for better performance. But now days increase in large networks increases routed traffic and reduces the stability of the network. The major causes for the degradation of the service performance are network congestion, link failures, and routing instabilities (Catherine Boutremans, Gianluca Iannaccone and Christophe Diot, 2002). In (Catherine Boutremans, Gianluca Iannaccone and Christophe Diot, 2002) it has been found that most of the disruptions occur during routing changes. A few hundred milliseconds of disruption are enough to cause a disturbance in voice and video (Renata Teixeira and Jennifer Rexford, 2006). A disruption lasting a few seconds is long enough for interrupting web transactions (Renate Teixeira and Jennifer Rexford, 2006). Hence, during routing protocol convergence data packets are dropped, delayed, and received out-of-order at the destination resulting thus in a serious degradation in the network performance (Catherine Boutremans, Gianluca Iannaccone and Christophe Diot, 2002). It is at this point that we need a system which is minimally invasive however completely independent and capable of taking decisions based on its initial system training and envelope boundaries and to develop and support such type of system it is necessary to support wide variety of network services such as web browsing, telephony, database access and video streaming hence it becomes important to analyze different routing protocols so that network resources are utilized more efficiently because routing protocols are the main factors contributing to speed-up data transfers within the network.

The main objective of this analysis is to implement the proposed routing protocols in networks to analyze the protocol performance theoretically and by simulation using weighted-faired queuing (WFQ) technique on wired protocols for different scenarios taking into consideration the users, services, and locations of the hosts and for wireless protocols simulating a Mobile ad hoc network with all nodes in the network receiving FTP and Video traffic from a common source (wireless LAN server). In addition, the mobile nodes were randomly placed in the network to provide the possibility of multihop routes from

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a node to the server. The performance of these routing protocols is evaluated with respect to network delay, throughput and CPU utilization, FTP download and uploads response time, packet end to end delay, IP traffic dropped and used this detailed simulation study for open source model architecture which could be used to auto assist the vehicle to its destination.

A. Weighted Faired Queuing

Weighted fair queuing (WFQ) (Mohammad Mirza, Golam Rashed and Mamun KabirA, 2010)) is a method of automatically smoothing out the flow of data in packet-switched communication networks by sorting packets to minimize the average latency and prevent exaggerated discrepancies between the transmission efficiency afforded to narrowband versus broadband signals. In WFQ, the priority given to network traffic is inversely proportional to the signal bandwidth. Thus, narrowband signals are passed along first, and broadband signals are buffered.

B. Open source architecture

IPv6 registration number, speed of the vehicle sent from the car to routing node and in turn relaying new speed, lane change information and next hop to data originator. Emergency on preference movement vehicles on path will be auto assigned to lane 1 and other traffic will be shifted to the other lanes. All information will be broadcasted in such scenario by these lamp posts.

Routing node R: It is used distance calculation and next route decision, time slot al for location, speed assignment and lane change information back to the vehicles. System will be fed with GPS maps and will be told its next hops on interfaces to guide a vehicle from any source to any destination.

Hence, we require some wired protocols to send information or data from one signal or lamp post to another signal or lamp post to routing node R so that we are analysing the RIP, OSPF and EIGRP protocols using different metrics.

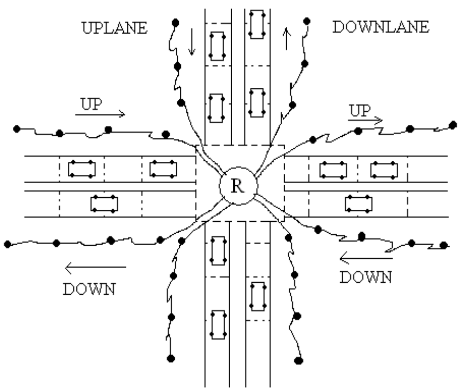

Fig. 1 Scenario of Centralized and Distributed Communication

Here we also require wireless communication between vehicles to send details to neighbouring vehicle about speed, timing etc so we are also analysing the AODV, DSR and OLSR protocols for vehicular communication.

2. Related Work

(Thorenoor and S.G, 2010) presents the implementation decisions to be made when the choice is between protocols that involve distance vector or link state or the combination of both. Here a comparison is made between different parameters and a detailed simulation study is performed on the network with different routing protocols and it has been shown that EIGRP provides a better network convergence time, less bandwidth requirements and better CPU and memory utilization compared to OSPF and RIP. Comparison among different MANET routing protocols based on different application is discussed in (Kiranveer Kaur, Surinderjit Kaur and Vikramjit Singh, 2014)A review of location area routing mechanism is proposed in (Neha Ghaisas, 2014).The proposed scheme performs a review of different routing protocols which can be used for Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) communication. It also discussed the need of location area routing mechanism to get the exact location of the cars through GPS and localization techniques to avoid collision and control congestion. (Mohammad Mirza, Golam Rashed and Mamun KabirA, 2010) present a comparative analysis of three queuing systems FIFO, PQ and WFQ. The study has been carried out on some issues like: Traffic dropped Traffic Received and packet end to end delay and the simulation results shows that WFQ technique has a superior quality than the other techniques. (Amandeep Verma, Dr. Manpreet Singh Gujral, 2011) present the analytical simulation results of routing protocols DSR, AODV, OLSR and GRP for two applications namely ftp and email, using the network simulator OPNET 14.0 and results shows that performance of DSR for all parameters is worst as compared to the other protocols. On the other hand OLSR is performing well for all parameters. A comparative performance analysis of these routing protocols has been presented in (Muhammad Shaffatul Islam Md. Adnan Riaz Mohammed Tarique, 2012) for supporting video streaming applications. In (Salman Naseer, S.A Hussain, I Raza, S R Chaudry, J. S. Mirza, M. H. Raza, 2012) different routing protocols of MANETs have been analyzed with performance metrics of throughput, end-to-end delay and network load by simulating multimedia (video conferencing) traffic. The simulation results show that proactive protocol OLSR outperforms than other protocols. In (Gagangeet Singh Aujla, Sandeep Singh Kang, 2013) a comprehensive simulation based performance study and analysis is performed on various types of routing protocols over MANET and the performance of these routing protocols will be measured on the basis of throughput, delay, load and data dropped metrics.

3. Simulation Setup

Network is simulated using OPNET® Modeler. OPNET® is extensive and powerful simulation software with wide variety of capabilities. It enables the possibility to simulate entire heterogeneous networks with various protocols.

3.1 Network Topology for RIP, OSPF and EIGRP

The simulated network topology for intra domain routing protocols as shown in the fig.14 consists of different applications employed by users such as engineers, researchers, salespeople, e commerce and multimedia users.

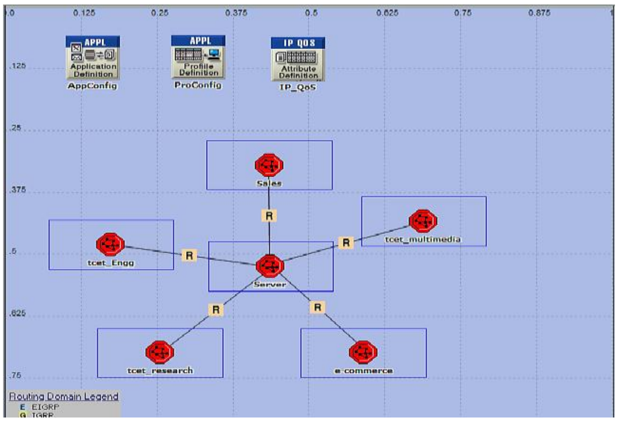

Fig.2 OPNET simulated network topology

In above simulation setup, Application Config is used to specify applications that will be used to configure user's profiles.

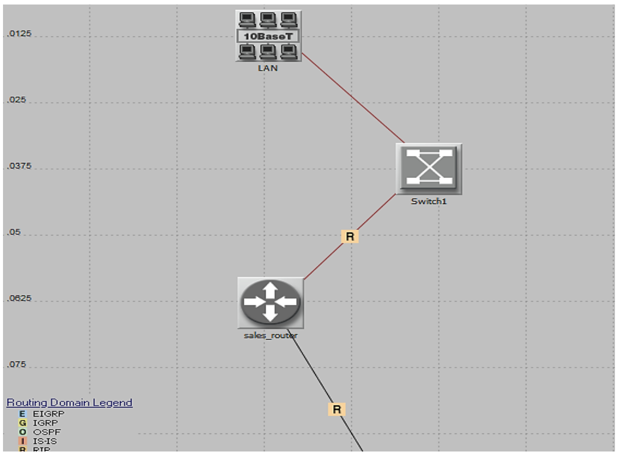

Fig.3 Server Subnet

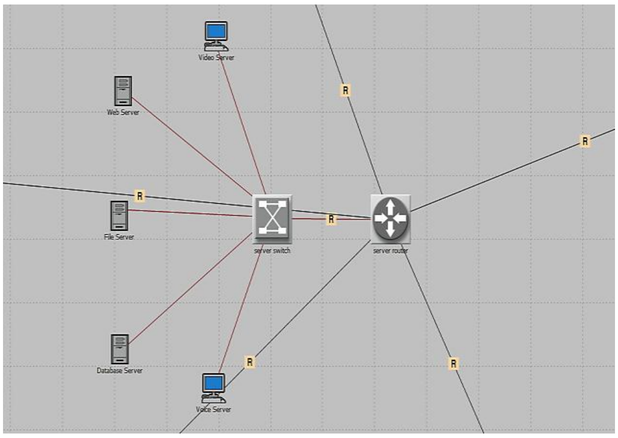

Fig.4 LAN Setup

Profile Config describes the activity patterns of a user or group in terms of the applications used over a period of time. Subnets are used for different applications and each subnet workspace is consisting of 10BaseT LAN, ethernet16Switch, and a 10BaseT link to connect the LAN and ethernet4_slip8_gtwy router with the Switch. All subnets are connected to server. The servers have to support the applications defined in the profiles we deployed.

3.2 Design parameter and simulation results wires protocols

We have analysed wired protocols (RIP, OSPF and EIGRP) based on delay, throughput, CPU utilization for FTP and Video application.

Delay: The parameter is queuing delay (sec) for each protocol.

Table 1 Queuing Delay

Queuing Delay (sec)		
RIP	**OSPF**	**EIGRP**
0.030291	0.014432	0.010269

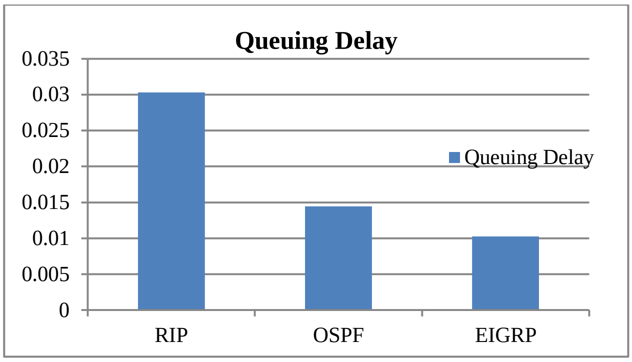

Fig.5 Queuing Delay (sec)

This parameter represents instantaneous measurements of packet waiting times in the transmitter channel's queue. Measurements are taken from the time a packet enters the transmitter channel queue to the time the last bit of the packet is transmitted. So based on comparative results shown above we can say that for EIGRP gives lowest delay compare to RIP and OSPF.

Throughput: The parameter is Throughput (bits/sec) for each protocol.

Table 2 Throughput

Throughput (bits/sec)		
RIP	**OSPF**	**EIGRP**
0.131	0.139	0.177

This statistic represents the average number of bits successfully received or transmitted by the receiver or transmitter channel per unit time, in bits per second. So based on comparative results shown above we can say that for EIGRP highest throughput compare to RIP and OSPF.

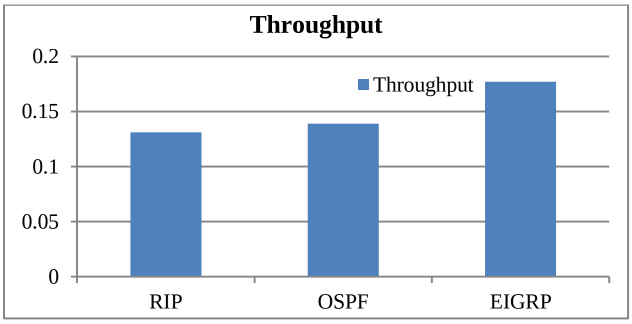

Fig.6 Throughput

CPU Utilization: The parameter is utilization.

Table 3 CPU Utilization

Utilization		
RIP	**OSPF**	**EIGRP**
0.822499	0.758038	0.755501

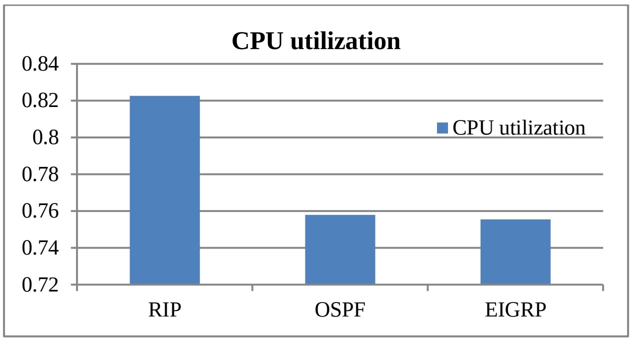

Fig.7 CPU Utilization

This statistic represents the percentage of the consumption to date of an available channel bandwidth, where a value of 100.0 would indicate full usage. So from results shown above we can say that EIGRP gives low CPU utilization.

FTP: It is necessary to determine how background traffic is affecting the ftp application, so we model the ftp traffic based on fig 4. Applications like ftp create trains of packets which move through the. These packets tend to congest the flow through the network and affect the higher priority traffic despite of them being low priority traffic.

Table 4 FTP

FTP		
RIP	**OSPF**	**EIGRP**
6.05214	5.97111	6.09961

We consider the average of FTP upload and download times and run all the routing protocols to determine which would provide the most optimum results for ftp. The parameters considered here are Download response time and Upload response time.

On basis of above results we could conclude that ftp would work best for OSPF protocol based on averaging of the parameters selected under standard network design.

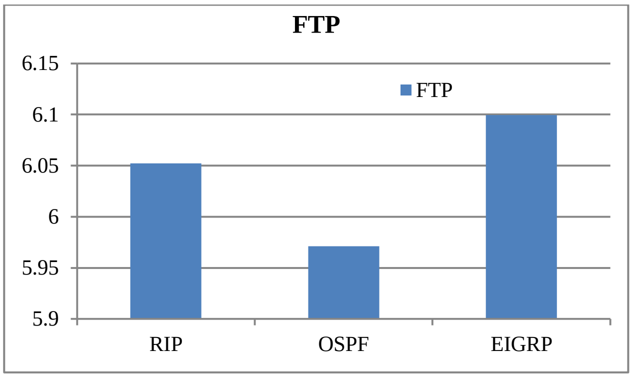

Fig.8 FTP

Video Conferencing: The selection of the appropriate protocol in real-time applications is more apparent, increasing in real-time demands, parameters such as End-to-End delay, can even lead to received video packets loss and sound quality reduction at the receiver side. These are based on profiles configured for video conferencing.

Table 5 Video Conferencing

Packet End To End Delay		
RIP	**OSPF**	**EIGRP**
3.190563	2.993941	2.577398

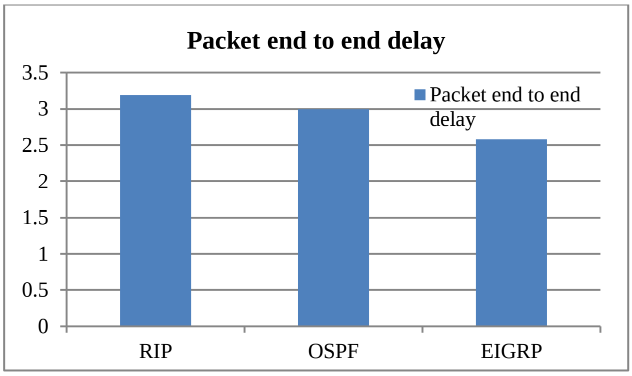

Fig.9 Video Conferencing

On the basis of above results for video conferencing we can conclude that real time application such as video conferencing and streaming would work best with EIGRP routing protocol.

3.3 Network Topology for AODV, DSR and OLSR

Figure 10 shows the simulation environment of one scenario having 20 mobile nodes for AODV, DSR and OLSR routing protocols. The different parameters are provided here such as throughput, delay and CPU utilization. We simulate twelve scenarios for 5, 20 and 50 nodes. Each scenario was run for 30 min (simulation time). All the simulations show the required results. Under each simulation we check the behavior of AODV, DSR and OLSR. We get multiple graphs from simulations for above applications. Main goal of our simulation was to model the behavior of the routing protocols. We collected DES (global discrete event statistics) on each protocol.

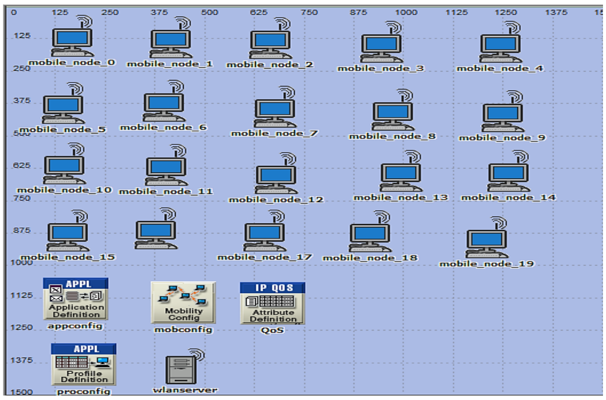

Fig.10 Network Topology

A campus network was modeled within an area of 1000m x 1000m. The mobile nodes were spread within the area. Random waypoint mobility model was used in this simulation.

3.4 Design parameter and simulation results of AODV, DSR and OLSR

We have analysed adhoc routing protocol (AODV, DSR and OLSR) based on Delay, Throughput, CPU Utilization for FTP and Video applications.

Delay: The parameter is wireless LAN Delay in seconds.

Table 6 Delay

Wireless LAN. Delay(sec)		
AODV	**DSR**	**OLSR**
0.053867	0.153011	0.065114

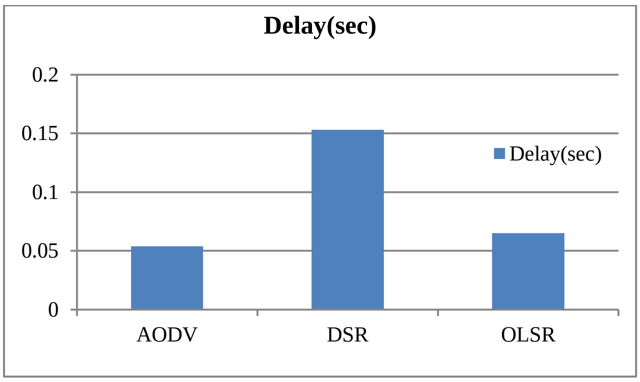

Fig.11 Wireless LAN. Delay (sec) of AODV, DSR and OLSR

This parameter represents the end to end delay of all the packets received by the wireless LAN MACs of all WLAN nodes in the network and forwarded to the higher layer. So on the basis of above results; we observe that in terms of Delay, AODV gives lowest delay compare to DSR and OLSR.

Throughput: The parameter is Wireless LAN Throughput in bits per seconds.

Table 7 Throughput

Wireless LAN. Throughput(bits/sec)		
AODV	**DSR**	**OLSR**
6926.338	127.1776	2153.668

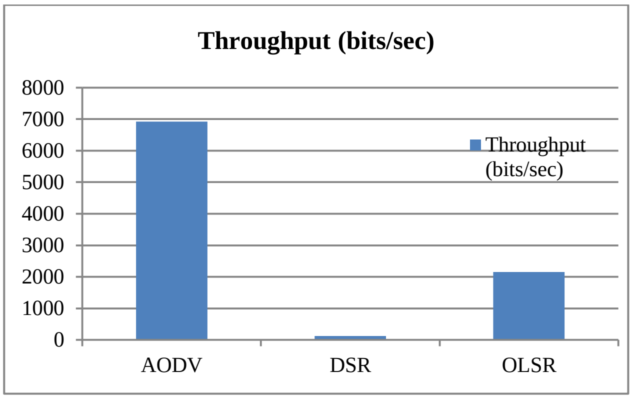

Fig.12 Wireless LAN. Throughput (bits/sec) of AODV, DSR and OLSR.

This statistics represents the total number of bits (in bits/sec) forwarded from wireless LAN layers to higher layers in all WLAN nodes of the network.

So from the above result we can say that AODV gives us lowest delay so that AODV gives us highest throughput compare to DSR and OLSR.

CPU Utilization: The parameter is CPU utilization in %.

Table 8 CPU Utilization

CPU Utilization (%)		
AODV	**DSR**	**OLSR**
1.423246	0.974857	6.69367

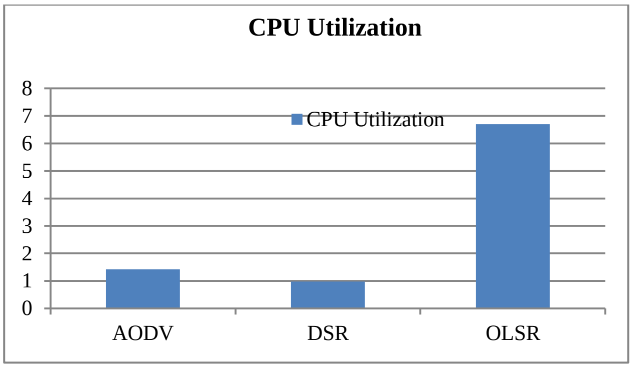

Fig.13 CPU Utilization (%) of AODV, DSR and OLSR

This statistic reports the utilization, in percentage (%), of the 'Simple CPU'. The 'Simple CPU' is used to model the IP packet forwarding delays and application processing delays.

So from the above analysis we can say that CPU utilization of DSR is less compared to AODV and OLSR.

FTP: It is necessary to determine how background traffic is affecting the ftp application, so we model the ftp traffic based on fig 4. Applications like ftp create trains of packets which move through the. These packets tend to congest the flow through the network and affect the higher priority traffic despite of them being low priority traffic.

Table 9 FTP for AODV, DSR and OLSR

FTP		
AODV	**DSR**	**OLSR**
104.93	6.85	9.64

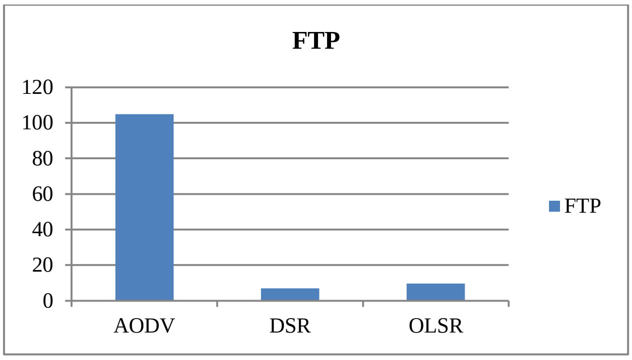

Fig.14 FTP for AODV, DSR and OLSR

We consider the average of FTP upload and download times and run all the routing protocols to determine which would provide the most optimum results for ftp. The parameters considered here are Download response time and Upload response time.

On basis of above results we could conclude that ftp would work best for DSR protocol based on averaging of the parameters selected under standard network design.

Video Conferencing: The selection of the appropriate protocol in real-time applications is more apparent, increasing in real-time demands, parameters such as End-to-End delay, can even lead to received video packets loss and sound quality reduction at the receiver side. These are based on profiles configured for video conferencing.

Table 10 Video Conferencing

Packet End To End Delay		
AODV	**DSR**	**OLSR**
1.828156	4.433438	5.64041

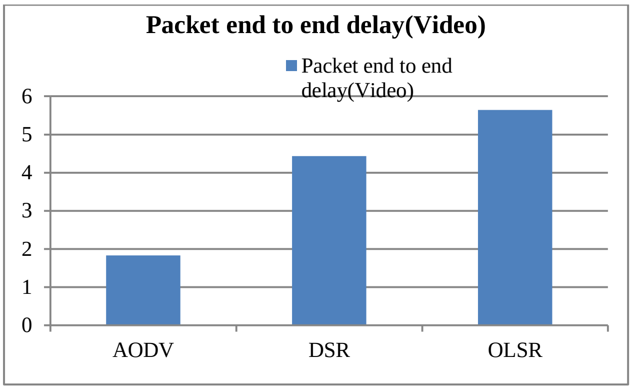

Fig.15 Video Conferencing for AODV, DSR and OLSR

On the basis of above results for video conferencing we can conclude that real time application such as video conferencing and streaming would work best with AODV routing protocol.

4. Comparative Analysis

From all above figures, graphs and table 10 and 11 we can see the behaviors of routing protocols and average values respectively.

Table 11 wired Protocols

Wired Protocols			
Parameters	**RIP**	**OSPF**	**EIGRP**
Delay	0.030291	0.014432	0.010269
Throughput	0.131	0.139	0.177
CPU Utilization	0.822499	0.758038	0.755501
FTP	6.05214	5.97111	6.09961
Video Conferencing	3.190563	2.993941	2.577398

Table 12 Wireless Protocols

Wireless Protocols			
Parameters	**AODV**	**DSR**	**OLSR**
Delay	0.053867	0.153011	0.065114
Throughput	6926.338	127.1776	2153.668
CPU Utilization	1.423246	0.974857	6.69367
FTP	104.93	6.85	9.64
Video Conferencing	1.828156	4.433438	5.64041

Conclusion and future work

This paper, we use a bottom-up-top design approach where we would like to find which routing protocols would serve best in terms of delay, throughput and CPU utilization for FTP and Video applications. So that we can use it for inter vehicular communication which is an application of wireless routing protocols.

So from the analysis of wired protocols, we can conclude that EIGRP delay is 33% lowest as compare to OSPF and 98% lowest compare to RIP such that ultimately the throughput will be high i.e. EIGRP gives 20% better throughput than OSPF and 29% better throughput than RIP. EIGRP also offers low CPU utilization on the network as compared to RIP and OSPF and in terms of network services, EIGRP will be the best choice for video application as compared to other protocols whereas OSPF gives better performance in case of FTP which means EIGRP is the best one in the network in all the parameters i.e. Delay, Throughput and CPU utilization, Video Conferencing service and after that OSPF will be the best choice.

From the analysis of wireless protocols; we can conclude that AODV delay is 1% lowest compare to OLSR and 10% lowest compare to DSR, AODV throughput is 68% better than OLSR and 98% better than DSR , DSR offers 0.5% better CPU utilization than AODV and 6% better than OLSR so we can conclude that for delay either AODV or OLSR will be the best choice but if we consider delay with throughput then AODV will be the best choice compare to OLSR and DSR and if we consider CPU utilization along with delay and throughput then also AODV is the best in network.

This is a design of a scalable network where design creation has already been done however we need to study the effect of different application such as FTP, Video conferencing on server load as well effect of nodes on QoS of applications to decide which wired and wireless protocol is best suited in which application so that we can use it as a communication protocol for intelligent transportation system. This will be done based on current scenario in the network using this profile as a guideline.

Above results be used in Intelligent Transportation System using Open source architecture which mentioned in the paper to find shortest path from source to destination, collision avoidance and detection.

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