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Analysis of the Dynamic Source Routing Protocol on the Performance of File Transfer Protocol and Video Conference Services in the Mobile AdHoc Network Simulation

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Abstract (Times 10pt)

Current technological advancements make it easier for users to do their work effectively and efficiently, including the use of wireless networks to exchange data via File Transfer Protocol (FTP) and video conferencing services (VCS). A Mobile AdHoc Network (MANET) is a wireless network technology that applies a dynamic set of nodes. Data transmission on the MANET does not require the use of devices such as base stations. Because each node on the MANET can act as a router in determining the direction of the data sent, the number of nodes in the MANET will influence the quality of the data sent. Using the OPNET Modeler simulator, this paper shows how to assess the quality of FTP and VCS based on delay, jitter, and packet loss parameters. The simulation scenario employs five, fifteen, and thirty nodes with low, medium, and high traffic loads, using the Dynamic Source Routing (DSR) protocol. According to the measurement results, the FTP service with the bad category is the packet loss parameter in high traffic loads, which has the highest packet loss value of 56.6 percent with 15 nodes. In contrast, “good" results for VCS are only produced on the delay parameter. The jitter increases with the number of nodes, and it is 5 in this case. In all scenarios, the packet loss parameter yields poor results, with the highest packet loss value approaching 100%.

Keywords: Quality of Service; Dynamic Source Routing; File Transfer Protocol; Video Conference; Mobile AdHoc Network;

Introduction

Technological developments make it easier for users to complete work effectively and efficiently [1]. Technology for exchanging data and communication namely the Mobile Adhoc Network (MANET) [2], [3] is one of the example. The development of computer network technology allows users to send or retrieve files to or from other users by using File Transfer Protocol (FTP) services. It is a protocol that serves the file transfer process on a computer network. Recently, users can also use computer networks to exchange data in the form of audio and video in real-time, which is popular in video conferencing. Video Conferences Services (VCS) is a real-time service that allows two-way communication in the form of data, voice, and images in a duplex or two-way manner [4], [5]. In addition to wired media, data transmission media in computer networks can be also wireless. One of the most popular wireless networks is the adhoc network. Adhoc network is a wireless network consisting of a collection of mobile nodes that are static or dynamic and spontaneous. It can also be applied anywhere without infrastructure network or access point.

MANET is an adhoc network consisting of several collections of mobile nodes that can communicate with each other in a dynamic topology without fixed infrastructure and centralized control [5]–[7]. Mobile nodes on the MANET network does not merely function as senders and recipients of data but also as routers that can determine the destination of the data sent. Therefore, the number of nodes in the network will affect the quality of the data sent [8].

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Research by [9] examines the performance of the MANET on VCS with different resolutions. This study uses the Ad-hoc On-demand Distance Vector (AODV) routing protocol with 2 to 20 moving nodes. The result showed that the quality of VCS with 15 fps frames for delay, jitter, and packet loss attributes increases in accordance with the increasing number of nodes. Another study by [10] analyzed the comparison between the AODV and Optimized Link State Routing (OLSR) routing protocols on MANET with FTP traffic categorized as low, medium, and high load with the highest number of nodes being 30. This study proposed that the OLSR routing protocol obtained better results than AODV for throughput and end-to-end attributes, delay, provided both still meet TIPHON standards. These two studies show that the performance results of several service quality attributes can be influenced by the number of nodes, traffic behavior and routing protocols used.

Based on above description, this study employs the OPNET Modeler simulator application to analyze the quality of FTP and VCS on MANET with a different number of nodes that move randomly, using a different routing protocol, namely DSR (Dynamic Source Routing). This routing protocol is suitable for small-scale networks [11], [12]. The attributes used as a measure of service quality assessment are delay, jitter, and packet loss.

Method

This research used dataset of nodes and communication devices. Laptops are presented as simulations using the OPNET modeller simulator 14.5. The Infinix Inbook x1 laptop was deployed as research tool while Microsoft Excel displays visualizations in analyzing the performance of services used on the Adhoc network. Each research objective was addressed using algorithm in the form of flowchart [13] which is shown in the figure 2.

A. Adhoc Network Topology Design Scheme

The Adhoc network topology design scheme in this study applies a simulation area of 100 meters x 100 meters using the MANET network type. The topology of the MANET network is a collection of moving nodes. The number of nodes used in this simulation is 5, 15 and 30 nodes where one node acts as a server node and the other as a client node. The nodes in this simulation are randomly placed and move randomly in all directions within the scope of the simulation area. An illustration of the topology can be seen in **Figure 1**.

Figure 1. Manet Network Topology Schematic with Different Number of Nodes

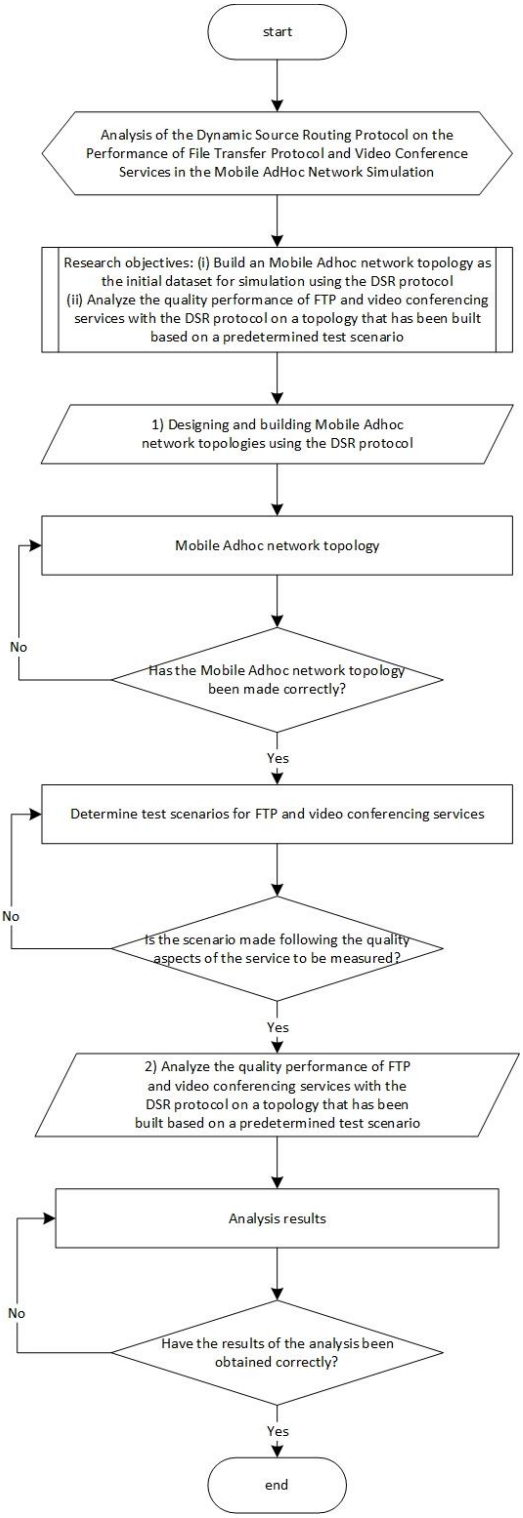

Figure 2. Research Method Flowchart

B. Determination of scenario simulation schemes and testing of services

Attributes in this study consist of several variables related to the simulation activities carried out. Attribute values for each scenario will be distinguished to be used as a benchmark for the quality of FTP and VCS traffic services. Simulation attributes for FTP and VCS can be seen in **Table 1**.

Table 1. Attributes Used in The Simulation

Attribute	Services and Value				
	FTP Low Load	***FTP Medium Load***	***FTP High Load***	***VCS Low Resolution***	***VCS High Resolution***
Service Type	1000 bytes	5000 bytes	50000 bytes	128 x 120 px; 10 fps	128 x 240 px; 15 fps
Number of Nodes	5,15,30				
Mobility Nodes	Random				
Simulation Area	100 meters x 100 meters				
Simulation Time	5 minutes				
Data Rate	11 Mbps				
Routing Protocol	DSR				

Based on **Table 1**, the types of services used in this simulation are FTP services with low, medium, and high load variations and VCS with low- and high-resolution load variations. The simulation time is 5 minutes with a data rate of 11 Mbps using the DSR protocol as a routing protocol on the MANET network.

C. Determination of attributes for measuring service quality

To determine the quality of FTP and video conferencing services on the MANET network, three service quality attributes must be considered [14], [15]. The output results of these three attributes will then be classified based on TIPHON standardization [16]. The three observed service quality attributes followed by the standardization table [17] are provided below:

1. Delay

   Delay is the time it takes for data to travel from the point of origin to the point of destination. Delay can be affected by media, distance, jams, and processing time [6]. The classification of delay according to the TIPHON standard can be seen in **Table 2** [7]. The delay value can be calculated using the following equation:

   Delay = time the packet was received (ms) – the time the packet was sent (ms) (1)

2. Jitter

   Jitter is a delay variation, often referred to as the difference in arrival time between packets at the destination terminal [8]. Classification of jitter can be seen in **Table 2**. The jitter value can be calculated using the following equation:

   $$\text{Jitter} = \frac{\text{total delay variation}}{\text{total received packets}} - 1 \quad (2)$$

   $$\text{Total variation of delay} = (\text{delay}_2 - \text{delay}_1) + (\text{delay}_3 - \text{delay}_2) + \ldots + (\text{delay}_n - \text{delay}_{n-1}) \quad (3)$$

3. Packet Loss

   Packet loss is the number of packets lost when sending data packets from source to destination [8]. Classification of packet loss can be seen in **Table 2.** The value of packet loss can be calculated using the following equation:

   $$\text{Packet loss} = \frac{\text{data packets sent} - \text{data packets received}}{\text{data packets sent}} \times 100 \quad (4)$$

Table 2. The Value of Service Quality Based on The Tiphon Standard

Index	Category			Value (ms)		
	Delay	***Jitter***	***Packet Loss***	***Delay***	***Jitter***	***Packet Loss (%)***
4	Very Good	Very Good	Very Good	<150	0	0
3	Good	Good	Good	150 – 300	1 – 75	3

Index	Category			Value (ms)		
	Delay	*Jitter*	*Packet Loss*	*Delay*	*Jitter*	*Packet Loss (%)*
2	Medium	Medium	Medium	300 – 450	75 - 125	15
1	Bad	Bad	Bad	>450	125 - 225	25

Results and Discussion

A. The Results Of Measuring Service Quality Based On The Delay Attribute

Table 3 and Figure 3 show the results of delay attribute on FTP services with low, medium and high traffic loads. The resulting output is different for scenarios of 5, 15 or 30 nodes. The highest increase in average delay occurs in the FTP service scenario with low traffic load when the number of nodes is 15. This occurs because data is sent at one time resulting in only one delay. The conditions are different when the number of nodes is 30, the data is sent in several times so that there is more than one delay with a greater total delay. Delivery made at several times affects the average delay value. The average delay results in other scenarios are below 10 ms.

Table 3. The Average Value of The FTP Service for The Delay Attribute

Number of Nodes	Average delay for FTP (ms)		
	Low	*Medium*	*High*
5	6.511	2.735	4.780
15	22.046	4.742	9.367
30	9.355	9.001	8.336

The average delay value for scenarios 5, 15 and 30 with low, medium and high traffic loads is still below <150 ms. According to the TIPHON standard, the delay is included in the very good category.

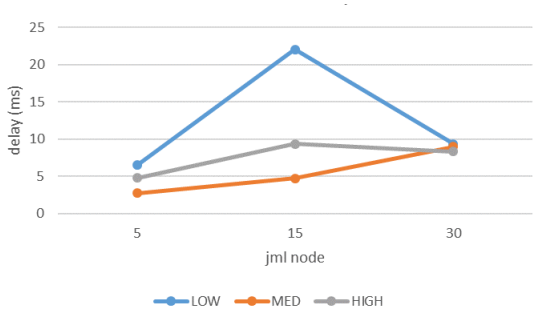

Figure 3. Visualization Of the Average FTP Service Value for The Delay Attribute

Referring to the Table 4 and Figure 4, the average delay value on the VCS has increased significantly in accordance with the increasing number of nodes. The more nodes in the network, the higher the average delay value. The highest value is found in the scenario of 30 nodes at a low traffic load, which is 13129.185 ms. This value is similar to high traffic load which is 12092.865 ms.

Table 4. The Average Value of VCS for The Delay Attribute

Number of Nodes	Average delay for video conference (ms)	
	Low	*High*
5	120.294	183.149
15	5882.763	4660.134
30	13129.85	12092.865

The average delay value for VCS is categorized using the TIPHON standard. The results obtained are scenarios of 5 nodes with low traffic loads categorized as very good, scenarios of 5 nodes with high traffic loads are categorized as good, while scenarios 15 and 30 nodes are categorized as bad so they are not recommended for use.

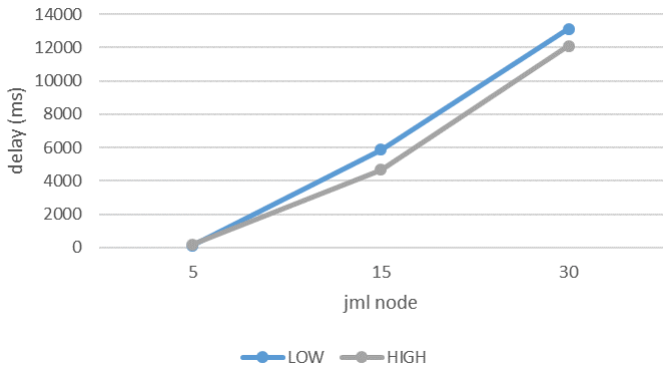

Figure 4. Visualization Of the Average Value of VCS for The Delay Attribute

The increase in the output delay value is influenced by how the DSR routing protocol works. The message transfer between nodes requires a route discovery mechanism so that the greater the number of nodes, the greater the number of broadcast packets on the route discovery mechanism

B. The Results of Measuring Service Quality Based on the Jitter Attribute

As illustrated in **Table 5** and **Figure 5**, the average jitter values for FTP services with low, medium and high traffic loads with 5, 15 and 30 nodes are still less than 75 ms. According to the TIPHON standard, these results are categorized as moderate. The average jitter value is 0 (no jitter) for low FTP traffic loads on both node 5 and 15 scenarios because it only produces a one-time delay value, while in the 30-node scenario, the average jitter value is 9.777 ms. On the other hand, FTP services at medium traffic loads produce an average jitter value of 1.114 ms, 3.655 ms, and 4.527 ms for a scenario of 5, 15 and 30 nodes respectively. Meanwhile, for FTP services with high traffic loads, all average jitter is less than 10 ms for all scenario which are 1.634 ms, 4.422 ms and 4.819 ms for 5, 15 and 30 nodes respectively.

Table 5. The Average Value of The FTP Service for The Jitter Attribute

Number of Nodes	Average jitter for FTP (ms)		
	Low	***Medium***	***High***
5	0.000	1.114	1.634
15	0.000	3.655	4.422
30	9.777	4.527	4.819

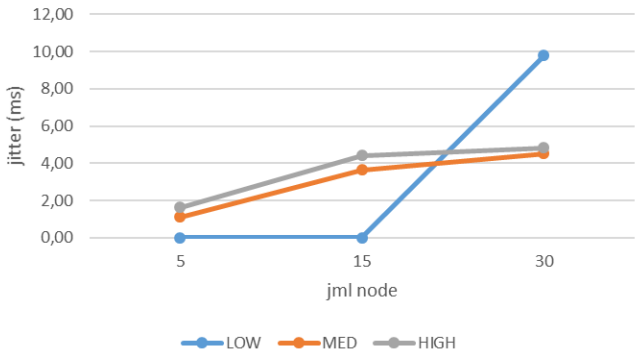

Figure 5. Visualization Of the Average Value of The FTP Service for The Jitter Attribute

In VCS with low traffic loads, the jitter values generated for 5, 15 and 30 nodes scenario are 10.840 ms, 480.087 ms and 653.382 ms respectively. Based on TIPHON standard, both scenario 15 and 30 nodes are not recommended as they fall in the bad category.

Table 6. The Average Value of VCS for The Jitter Attribute

Number of Nodes	Average jitter for video conference (ms)	
	Low	***High***
5	10.840	6.548
15	480.087	579.015
30	653.382	701.785

Menawhile, for VCS with high traffic load, the average jitter value generated for 5 nodes scenario is 6.548 which is categorized as good under TIPHON standard. In contrast, the scenario of 15 and 30 nodes falling under bad category are not recommended with 579.015 and 701.015 average jitter value respectively.

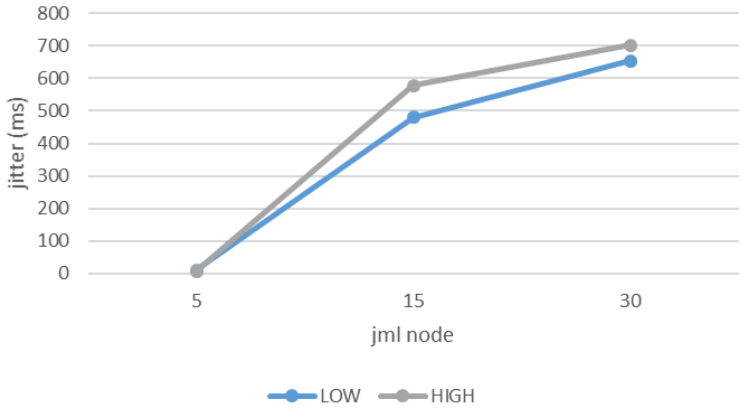

Figure 6. Visualization Of the Average Value of VCS for The Jitter Attribute

C. The Results of Measuring Service Quality Based on The Packet Loss Attribute

The simulation results in **Table 7** and **Figure 7** depict the value of packet loss for FTP services. For FTP services with low and moderate traffic loads in scenarios of 5, 15 or 30 nodes, packet loss is 0% or no packet loss. Based on the TIPHON standard, this value is included in the very good category. Whereas for high traffic load, the average value of packet loss for node 5, 15 and 30 scenarios are 27.27%, 56.60% and 54.96% respectively which are included in the bad category according to the TIPHON standard.

Table 7. FTP Service Average Value for Packet Loss Attribute

Number of Nodes	Average packet loss for FTP (ms)		
	Low	***Medium***	***High***
5	0,000	0,000	27,272
15	0,000	0,000	56,603
30	0,000	0,000	54,961

The average value of packet loss for VCS can be seen in table 8 and figure 8.

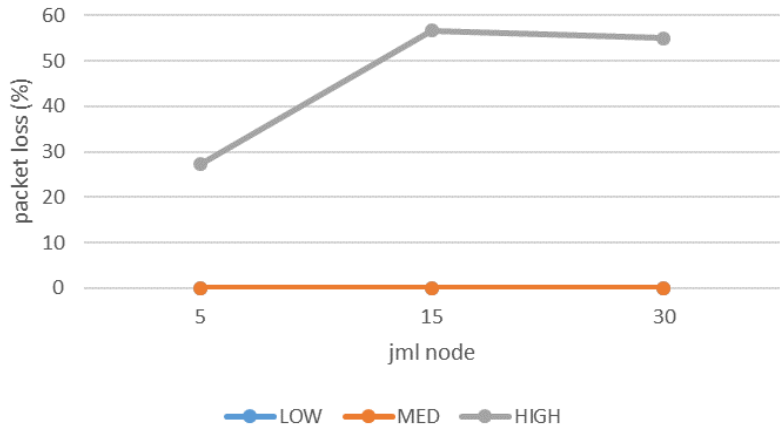

Figure 7. Visualization Of FTP Service Average Value for Packet Loss Attribute

As portrayed in **Table 8** and **Figure 8**, the average packet loss for VCS with low traffic loads in scenario of 5, 15 and 30 nodes are 59.26%, 97.82% and 97.96% respectively. At the same time, in the scenario of high traffic load, the average packet loss is 99.97% for five nodes, 99.98% for 15 nodes, and 99.99% for 30 nodes.

Table 8. The Average Value of VCS for Packet Loss Attributes

Number of Nodes	Average packet loss for VCS (ms)	
	Low	***High***
5	59.266	99.972
15	97.827	99.987
30	97.968	99.998

Since the packet loss for all scenario is greater than 25%, this attribute is included in bad category according to TIPHON standard. Thus, it cannot be recommended to be used.

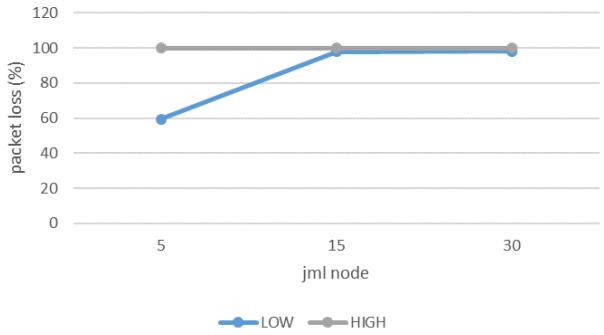

Figure 8. Visualization Of the Average Value of VCS for Packet Loss Attributes

Conclusion

Several results that can be concluded from the simulation related to the quality analysis of FTP and VCS on the MANET network are as follows:

1. Based on the delay attribute, the FTP service test produces an average delay value of less than 150 ms in all scenarios, which means it is in a very good category. Whereas in VCS, good results are only obtained in scenarios of five nodes.
2. Based on the jitter attribute, the FTP service test generates an average jitter value falling under good category in all scenarios. Meanwhile, results with good categories are only obtained in scenarios with five nodes for VCS.

3. Based on packet loss attributes, the FTP service produces bad category of packet loss in all scenarios for high traffic loads with the highest packet loss value of 55.6%. VCS, on the other hand, is included in bad category for all scenarios, with the highest packet loss value of almost 100%.

Suggestion for further research development is to carry out tests using reliable hardware or devices that have high memory specifications so that trials with more than 30 nodes could run optimally. Additionally, it is suggested to use various other routing protocols such as GRP, AODV and DSDV with other simulator devices such as network simulator 2 (ns-2) as a comparison to get performance results from FTP and VCS quality which varies based on the number of nodes.

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