Performance of Routing Protocol in MANET with Combined Scalable Video Coding

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***Abstract*— Development of wireless network technology to support various types of information services continues to increase especially in video streaming services. Video transmission especially in Mobile Ad Hoc Network (MANET) environment used in this research, particularly in the Combined Scalable Video Coding (CSVC) scheme which is a development of H.264 / MPEG-4. The contribution of this research focuses on the analysis of the performance of AODV, DSDV and DSR routing protocols in the MANET environment for CSVC, which is a new scheme in the development of H.264 / MPEG-4 video schemes. Performance evaluation are measured using the NS-2 simulation that supports MANET environment. As test metrics in this study are the end-to-end delay and PSNR. The test result shows the end-to-end delay in AODV is 0.60 seconds; this is lower than results on DSDV and DSR. On PSNR, DSR simulation results show 16.2 dB. This result exceed those in AODV and DSDV. The results of this research evaluation are influenced by channels in wireless networks, the larger the wireless network channel the more streaming video frames can be accepted by the destination node.**

Keywords— CSVC; End-to-end delay; NS-2; MANET; PSNR

I. INTRODUCTION

Application of wireless networks is increasing with mobility and capability in the transmission of various types of information formats. The number of users continues to increase generally often lead to problems in the delivery of data, especially in video format.

The advances in hardware used in video delivery on wireless networks make it a challenge in many studies, video streaming is synonymous with multimedia services mainly in the video transmission between devices in a wireless network is the object of a challenge in testing the capabilities of wireless networks.

Development of H.264 type video scheme / MPEG-4 is the Combined Scalable Video Coding (CSVC) which is a method that combined scalable and more adaptive in the process of transmission of video in streaming video services [1], [2], [3].

Routing protocol serves to select routes by disseminating information on computer networks. In this study routing protocols can be classified in reactive routing protocols and proactive routing protocols [4], [5].

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In this research, routing protocols running in the scheme of Mobile Ad Hoc Network (MANET) and CSVC in simulation Network Simulator (NS-2) which is a network simulator in wide - range models like computer networks in real medium and presents flexibility in the considered problem.

The paper proposed a scheme CSVC on routing protocols in MANET environments. The scheme is expected to contribute to improving the bit stream performance in MANET. Parameter tests using end-to-end delay and Peak Signal to Noise Ratio (PSNR) on the routing protocol used in Network Simulator 2 (NS-2) in MANET environments. This paper is presented as follows section 2 presenting about MANET as well as routing protocol used. CSVC scheme presented in section 3, analysis and conclusions in sections 4 and 5.

II. OVERVIEW OF MOBILE AD HOC NETWORK

A. Routing Protocols in MANET

The Wireless network plays an important role in everyday life, among other forms of wireless networks; MANET is a widely used wireless network model. MANET is a collection of nodes that communicate with each other and able to move freely with a simple infrastructure [4], [5]. Because it is a cooperative network then MANET is a reliable wireless network model in video transmissions [1], [2], [6]. Implementation of transmission in MANET can be seen in Figure 1.

Nodes in MANET communicate using routing protocols. Routing protocols are classified into three parts such as reactive routing protocols, proactive and hybrid routing protocols [4], [5], [7]

Characteristics of reactive protocols only search for destination node routes according to demand, for example, Ad-hoc On-demand Distance Vector (AODV) and Dynamic Source Routing (DSR).

Proactive routing protocol has a process of maintaining the route, check and evaluates the path continuously from each node. An example of this protocol is Destination-Sequenced Distance Vector (DSDV). The Hybrid routing protocol is an enhancement of the performance pattern of reactive and proactive routing protocols [4], [5].

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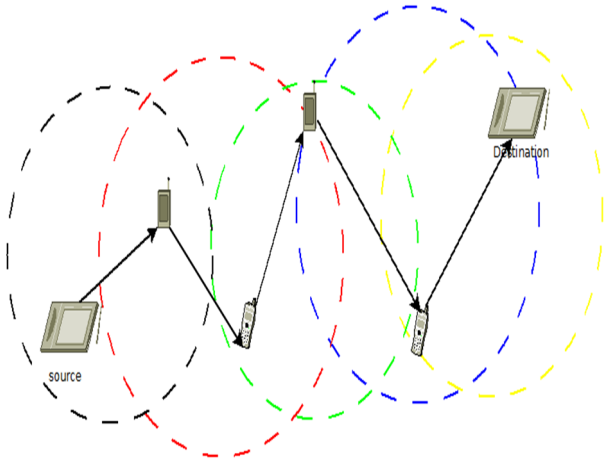

Fig. 1. Transmission on MANET

In this article, the focus in the performed experiments are only on the AODV, DSDV and DSR routing protocols. Previous studies have used routing protocol AODV, DSR, and DSDV operating in MANET environments for an efficient route with a varying number of nodes [5] and high delay [7].

Video transmission provides its own challenges in MANET, in line with technological developments that affect the development and application of technology video bit stream [8]. Human needs in video transmission over wireless networks are increasingly important, especially in MANET, CSVC is a video transmission scheme offered in this study because CSVC is constructed so that the more flexible video sent through adaptive wireless networks such as MANET.

B. Ad-hoc On-demand Distance Vector (AODV)

AODV is the routing protocol created using a combination of on-demand and distance vector protocol. AODV works by source node sending a message to the destination node that it will build a Route Request (RREQ). The origin node spreads the HELLO message to all nodes close to it then the node transmissions the HELLO message to the next node, thus producing a path from several hops to the destination. When a number of connected nodes resend to the source node that results in a route to the destination, this process is called Route Response (RREP). Routes constructed from each node from source to destination are called hop-by-hop state [4], [5], [7].

C. Destination-Sequenced Distance Vector (DSDV)

DSDV is a development of the Bellman-Ford algorithm. In DSDV, each node constructs a routing table and periodically transmits its routing table to the next node. When a route change occurs then the node immediately alters the route table of the last routing table data transmission, Then the node sends a new route table in two ways that are the full dump or incremental update [4], [5], [7].

D. Dynamic Source Routing (DSR)

DSR is a routing protocol designed for wireless networks of mobile nodes. Node allowed to move dynamically in determining source routes to destinations within an Ad hoc Network.

DSR has two main mechanisms, Route Maintenance and Route Discovery. Route maintenance is used when a route change occurs on the DSR, then the route is stored in the route caches which will then be used as a new route. The route search method is similar to the mechanism in AODV [4], [5], [7].

III. COMBINED SCALABLE VIDEO CODE

Combined Scalable Video Code (CSVC) is a combined form of structure as well as the efficiency of SVC encoding, CSVC is a development of H.264. CSVC was built to make the video sent more flexible on the transmission line and multicast in the network [1], [2].

CSVC is a combination of three types of scalable including Signal Noise to Ratio (SNR), Temporal and Spatial [1], [2], [3]. CSVC has one base layer and two additional layers that are combined in a block diagram of the encoder-decoder into 3 layers of scalable in which each layer can obtain predictions from the lower layers.

The base layer in CSVC forms the Quarter Common Intermediate Format (QCIF) format, a format that has a 176 x 144 pixel size that works for the smallest size images. While 2 additional layers using Common Intermediate Format (CIF) format with pixel size 352 x 288 which is utilized in video transmission.

SVC has benefits as a solution in video transmission systems such as graceful degradation, Bitrate adaptation, the adaptation of formats for feedback to more competent extensions and adaptations to energy [6], [8], [9], [10].

IV. RESULT ANALYSIS AND DISCUSSION

A. Methods and Experiment Design

In this section aims to discuss the models and methods in the design scheme that is implemented, the method used can be explained through several stages as follows:

- Set up Joint Scalable Video Model (JSVM) which is the standard used for building CSVC.
- Settings on NS-2 simulation tool.
- Implementation of CSVC and routing protocols in NS-2, where routing and CSVC protocols are run on scenarios created in the MANET environment in NS-2.
- Implementation JSVM in NS-2 scheme, in this stage JSVM applied to the scheme NS-2.
- Stage Analysis is the final stage when simulation experiments have been completed. Results obtained in the analysis are displayed in graphical form along with the average calculation results of each experiment by which conclusion can then be drawn based on the experiments performed.

B. Experimental Scheme

The experiments carried out were the development of the scheme [2], [11], where the experiments performed can be illustrated as in Figure 2.

In Figure. 2 the explanation component of the experimental scheme is as follows:

- The first video sequence is inserted into the scheme, where video files use H.264 standard.
- Then the video enters the encoder process stage of CSVC.
- The result of the encoder goes to the next stage of the process, where the result of the video encoder is already in the form of bit streams which are then extracted in the CSVC Extractor Stream Bit process.
- The output from the Bit Stream Extractor in the form of filtered trail, and then trace the trail into the NS-2 as simulation tool.
- After the process is completed in the NS-2 environment, the trace enters on the NALU filter which is then extracted again in the Bit Stream Extractor process.
- Results from the Bit Stream Extractor enter the decoder stage, where the frame is filtered and sequenced on the YUV video recipient sequence.
- In the last stage, the frame filter results is analyzed using PSNR analyzer to determine the quality of the received video.

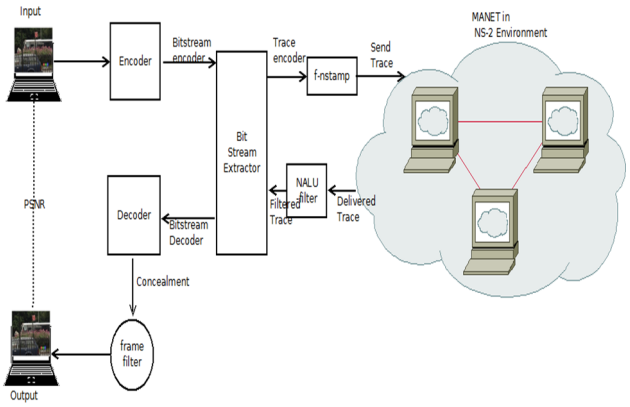

Fig. 2. Experiment Scheme

In this research, the experimental scenario of AODV, DSDV and DSR routing protocols is implemented in CSVC scheme. Routing performance analysis in the NS-2 environment uses a MANET scheme that matches CSVC on the wireless network.

C. Parameters and Scenario

In this Experiment some parameters are used to construct the simulation on NS-2 in a wireless network, table 1 is the simulation parameter used.

TABLE I. PARAMETERS IN SIMULATION

Simulator	NS-2.35
MAC type	802.11
Number of nodes	6
Duration	50 Seconds
Simulation area	400 m x 500 m
Routing Protocol	AODV, DSDV, DSR
Codec	JSVM 9.18 (H.264)/CSVC
Data Rate	1 Mbps
Antenna	Omni antenna
Number of frames	150 frames
Video	Bus CIF

In this research scenario is built using 6 nodes move freely and randomly in the region were designed. The scheme is based on figure 2 on the MANET environment in NS-2. To obtain accurate data, the test performed 5 times on each routing protocol, test parameters of the AODV, DSDV and DSR routing protocols in this experiment are the end-to-end delay and PSNR, where the values obtained in each experiment in the simulation are taken from the average calculation. Calculations and analysis mean using equation (1) are as follows:

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} \quad (1)$$

Where $\bar{x}$ is the mean, x_i is the sample value to i and n is the amount of data. After obtaining the average value on each trial then the next stage is calculated to obtain the total value of the average.

D. Evaluation of Experimental Results

The parameters used to evaluate the scope of this research are described as follows comparison of routing protocols for end-to-end delay in this experiment The average simulation results show that AODV has a low end-to-end delay value of 0.60 sec which can be seen in Figure 3, from AODV experimental results indicate that the number of packets reaching the destination node is less, although have a little delay, compared to the DSDV with an average end-to-end delay of 0.65 seconds in the same experiment.

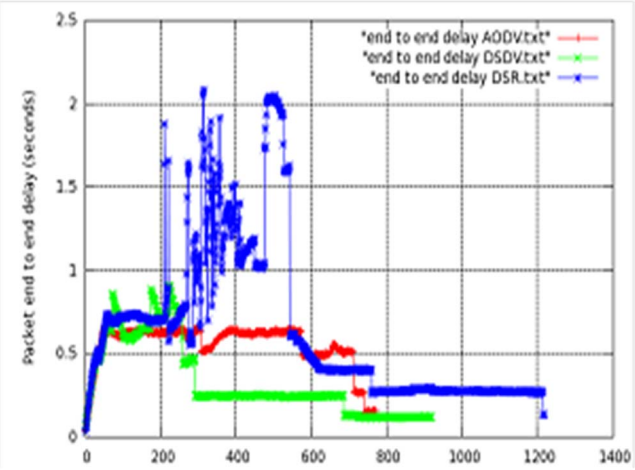

Fig. 3. End-to-end Delay CSVC in MANET environment

Routing Protocols DSR has higher end-to-end delay than AODV and DSDV, which is 1.04 seconds. Although it has higher delay, number of packets received at the destination nodes were more than AODV and DSDV because the nature of the DSR is multi-hop and has a route maintenance and route discovery mechanism, overview of the experimental results can be seen in Figure 3 which illustrates end-to-end delay for CSVC in MANET environments.

Testing and analysis of video inputs in this research using the 150 frame Bus CIF file. PSNR is used to measure the result among the original sequence and the reconstructed one. Formulation PSNR contained in equation (2).

$$PSNR = 10log_{10}\frac{(2^n-1)^2}{MSE} \quad (2)$$

The result of the average analysis has still used equation (1). From experiment results of this research, the average total PSNR taken is the average total value of Y-PSNR as a result of the simulation of the CSVC scheme. In this research DSR has a good Y-PSNR which is 16.2 dB compared to 10.3 dB in AODV. DSDV Y-PSNR result has an average value of 10.5 dB. The quality of packets arriving at the destination node is affected by the transmission channel during transmissions on the wireless network in the MANET environment along with the number of frames received. In Figure 4 can be seen more and more video frames are received so that on testing the quality of PSNR on the DSR protocol is better in terms of number of frame quality received by the destination node. In the decoder process, the packet received and the number of video frames which can be filtered are more than the DSDV and AODV routing protocols. In this research, the PSNR simulation results obtained from each routing protocol is still below the minimum standard determined by MPEG that is 25 dB.

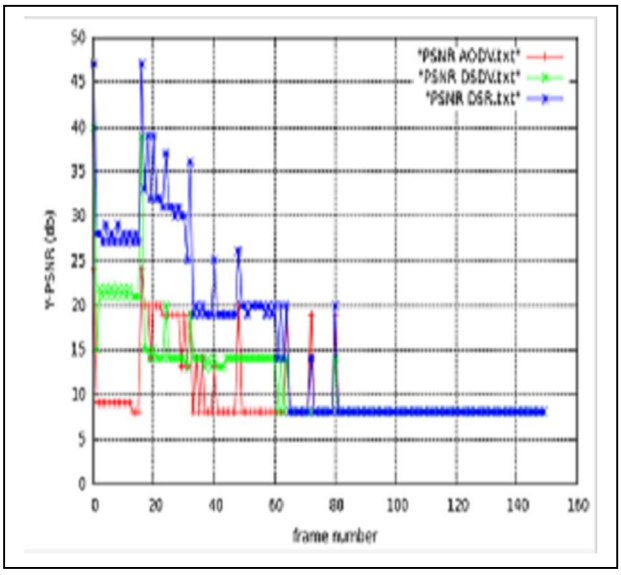

Fig. 4. Y-PSNR CSVC in MANET environment

V. CONCLUSION

This paper present the result from the performance analysis of AODV, DSDV and DSR routing protocols in the MANET environment with CSVC scheme which is the development of H.264 video environment. The results of the simulation analysis using end-to-end and PSNR test metrics. The simulation results show that end-to-end delay in the AODV routing protocol is lower than the DSDV and DSR routing protocol is 0.60 seconds, but the PSNR parameters obtained by the DSR routing protocol are better than the performance of AODV and DSDV routing protocols of 16.2 dB.

For future work, it is planned to increase the number of nodes and number of video frames for analysis of the performance of the three routing protocols (AODV, DSDV, and DSR) in the MANET environment.

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