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PERFORMANCE EVALUATION OF ADHOC PROTOCOLS: AODV AND DSDV FOR MOBILE NODE REQUIREMENT USING NS-2

A. A. Waskita, D. Andiwijayakusuma, Deswandri, Geni R. Sunaryo
Center for Nuclear Reactor Technology and Safety, National Nuclear Energy Agency, Kawasan Puspiptek Serpong, Tangerang 15310, Indonesia
email: adhyaksa@batan.go.id

ABSTRACT

PERFORMANCE EVALUATION OF ADHOC PROTOCOLS: AODV AND DSDV FOR MOBILE NODE REQUIREMENT USING NS-2. A performance evaluation of adhoc routing protocol of AODV and DSDV have been performed using NS-2 software. This evaluation was conducted to know which protocol was performed better in a mobile condition. The performance of both protocols is determined by the factor of the higher rate of Packet Delivery Fraction and the lower rate of Average end-to-end delay in a different number of nodes, the packet size and the maximum speed of nodes. From the simulation result, AODV shows good performance compare to DSDV in a mobile node requirement.

Keywords: performance evaluation, AODV, DSDV, mobile nodes, NS-2

ABSTRAK

EVALUASI KINERJA PROTOKOL ADHOC: AODV DAN DSDV UNTUK NODE BERGERAK MENGGUNAKAN NS-2. *Evaluasi kinerja protokol routing adhoc, AODV dan DSDV telah dilakukan menggunakan perangkat lunak NS-2. Evaluasi tersebut dilakukan untuk mengetahui protokol yang berkinerja baik pada kondisi bergerak. Kinerja kedua protocol ditentukan oleh tingginyafaktorPacket Delivery Fraction dan rendahnya faktorAverage end-to-end delay pada jumlah node berbeda, ukuran paket serta kecepatan maksimum node. Dari hasil simulation, AODV menunjukkan kinerja yang lebih baik daripada DSDV pada kasus node bergerak.*

Kata kunci: evaluasi kinerja, AODV, DSDV, node bergerak, NS-2.

INTRODUCTION

The wireless devices are currently getting their popularity and have been succesfully implemented in a number of applications, such as environment monitoring [1], a rescue scenario [2], a smart e-health [3], or an aplication of the IoT in a home automation [4]. In evaluating the performance of adhoc protocol, a number of researches uses NS-2 software [5-6], including the performance of the protocol in a specific case, such as intrusion detection scenario [7].

Research activity [8] that evaluate the performance of AODV (Ad-hoc On-Demand Distance Vector Routing), DSDV (Destination-Sequenced Distance Vector) and DSR (Dynamic Source Routing) has been performed in a fixed number of nodes and packet size. Performance evaluation that consider mobility of nodes are becoming useful for a scenario it requires [9].One example of mobile application equipped by the wireless sensor network is VANET (Vehicular Ad hoc Network) [10]. In this paper, the performance evaluation of AODV and DSDV mobile network protocols from different class [11] was simulated by using the NS-2 software. Their performance was determined by the two parameters, each the higher rate of Packet Delivery Fraction and the lower rate of Average end-to-end Delay respectively. After conducting a simulation, the implementation of a mobile network can be optimized from the perspective of the protocol, the packet size, the number of mobile nodes and its maximum speed in order to get the good result.

MOBILE ADHOC NETWORK PROTOCOLS

MANET devices can be described with the following characteristics.

- MANET (mobile ad hoc networks) was defined as the mobile devices with wireless links, that formed a kind of decentralized autonomous networks [9].

- It consists of dynamically establishing mobile nodes having short-lived networks in the absence of fixed infrastructure,
- equipped with wireless transmitter and a receiver with an appropriate antenna, and.
- easy deployment in places where existing infrastructure is not capable enough to allow communication, for instance, in disaster zones, or infeasible to deploy [11].

ROUTING PROTOCOL

In MANET, a number of routing protocols exist and can be classified as the following diagram inFigure 1. The classification is either reactive or proactive basis.

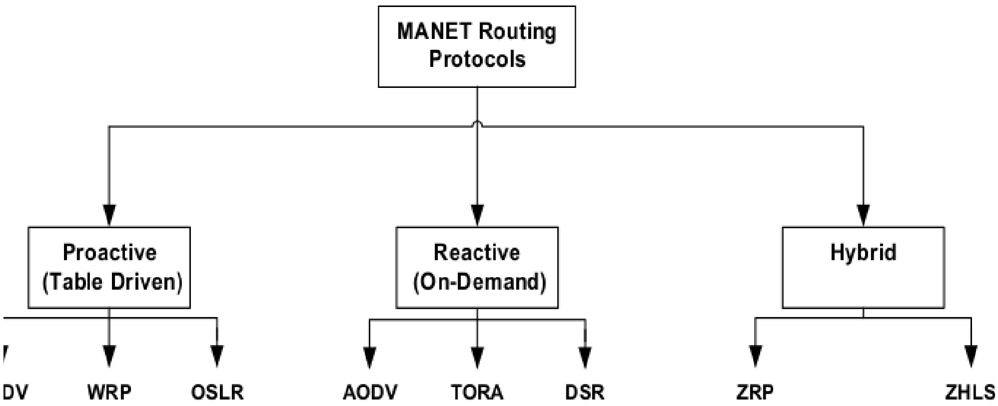

Figure 1. The classification of MANET routing protocol [12]

In a proactive routing protocol type, there exist a popular protocol, named DSDV (Destination-Sequenced Distance Vector) routing protocol. In this routing protocol, routing information is broadcast by mobile nodes to the neighbors. Each node must keep their routing table which contains the information of neighborhood nodes, reachable nodes and the number of hops. The routing table of each node is acquired by sending a broadcast massage to the other nodes [13]. In case of DSDV, every node in the mobile network is required to send a sequence number, which is periodically increased by two and it is transmitted along with other routing update messages to all other neighboring nodes [10]. Consequently, this routing protocol requires more storage spaces as the nodes involved increase.

On the other hand, the reactive routing protocol type, there exist a popular protocol, named AODV (Ad-hoc On-Demand Distance Vector Routing). In AODV, route establishment takes place only when there is a demand for new route [12].

METHODOLOGY

Scenarios

This research is intended to discover the performance of routing protocols of AODV and DSDV when a number of nodes involved, packet size or maximum speed of nodes changed. The evaluation will be conducted using the software called NS (Network Simulator) version 2 running on the top of GNU Linux operating system.

First of all, some scenarios are provided. Then, performance factors to be discovered are calculated.Packet Delivery Fraction (PDF) is a fraction of received to trasmitted packets. Packets are being considered are Constant Bit Rate (CBR) packet transmitted by CBR agent that embeded in a transmitted node. In NS-2 software, CBR is an application that uses UDP (User Datagram Protocol), the unreliable connection of a network layer. PDF is formulated as an equation (1). In equation (1), $CBR_{received}$ is a packet received, while $CBR_{generated}$ is a packet sent.

$$PDF = \frac{\sum CBR_{received}}{\sum CBR_{generated}} \times 100 \quad (1)$$

Average end-to-end delay (ETD) is a different time of packet received and sent divided by total number of packets being received. There is a possibility for a packet to lost or inable to reach a destination node. A sending packet that does not have a receiving one

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will be ommitted in a calculation. ETD is formulated as an equation (2). In equation (2), $CBR_{SentT\ ime}$ is a time for a packet being sent, while $CBR_{ReceivedTime}$ is a time a packet being received.

$$ETD = \frac{\sum CBR_{SentTime} - CBR_{ReceivedTime}}{\sum CBR_{received}} \qquad (2)$$

After that, each node will be defined as a part of NS code as depicted in Figure 2. Dimension of the simulated area was specified in line 9-10, while the packet size of bytes data can be varied in line 11. For configuring the interval between the consecutive packet sent can be made in line 12. Finally, variying the maximum of the speed of the nodes can be made in line 14.

```
1   set val(chan) Channel/WirelessChannel
2   set val(prop) Propagation/TwoRayGround
3   set val(ant) Antenna/OmniAntenna
4   set val(ll) LL
5   set val(ifq) Queue/DropTail/PriQueue
6   set val(ifqlen) 50
7   set val(netif) Phy/WirelessPhy
8   set val(mac) Mac/802_11
9   set val(x) 1000
10  set val(y) 1000
11  set val(cbrsize) 4096
12  set val(cbrinterval) 10
13  set val(stop) 500
14  set val(speed) 4
```

Figure 2. Node specification declaration

Each node will be located on a simulation area randomly using internal NS-2 tools called **cbrgen** and **setdest**.. These tools can be used to specify the number of mobile nodes involved, maximum number of connection among them, maximum speed of the nodes, types of application used and also the dimension of the area where the nodes occupies. Each time the influencing variables changed, these tools will be re-executed. The distribution of mobile nodes in a simulation area of 1000m × 1000m is illustrated inFigure 3.

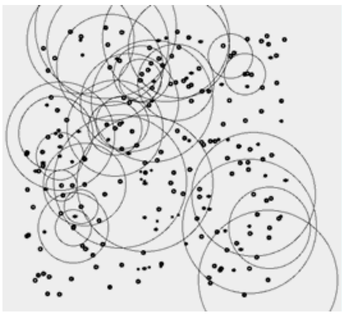

Figure 3. The distribution of the mobile nodes

Analysis tools

To calculate parameters PDF dan ETD, a simple tool is made in Python programming language. It is used to automatically calculate delay time between receiving and sending the same packet from a trace file. It uses the following two reguler expressions to extract important information from a trace file, each of them are receiving and sending CBR packet activities. The following are that two reguler expressions.

- ˆ(s)(\s)(\d)+\.(\d)+(\s)(_)(\d+)(_)(\s)(AGT).

- ˆ(r)(\s)(\d)+\.(\d)+(\s)(_)(\d+)(_)(\s)(AGT).

Packet which is started by a character s is a sending packet, while packet started by a character r is a receiving packet.

After collecting sending and receiving packet, recieving packet time will be reduced by the sending packet time which has the same packet ID. With the library from Python for processing text, each line of information is read and separated by a delimiter of a whitespace character. After being separated, time for sending and receiving packet will placed in second order, while packet ID will be placed in sixth order. These two variables will be placed in dictionary, a varible in Python for storing a pair information of key and value. Key information is a packet ID, while its value is time in sending and receiving packet. Each finding event of similar expression, either sending or receiving packet will be counted to determine PDF.

RESULT AND DISCUSSION

AODV Protocol

The first scenario is to perform simulation with increasing the packet size while the maximum speed of nodes is fixed. For PDF and ETD parameter, the result is shown in Figure 4 andFigure 5. The result showing that increasing packet size will increase packet loss. For a small number of nodes, the chart shows fluctuative result for every packet size. However, the larger number of nodes (above 50 nodes) shows consistent trend, which is around 50% to 90% of packets received. It is in line with the common sense that will be more packet lost for the larger size. From Figure 5, it shows that the larger the packet size the larger the delay time. Because of increasing packet size, time for delivering the packet is also increase. The largest ETDin the experiment is around 1.1 seconds.

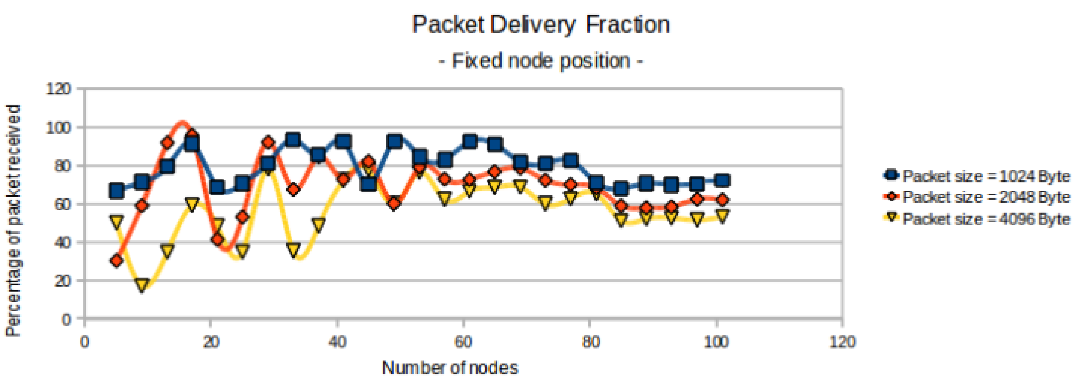

Figure 4. PDF for AODV protocol at the varying packet size and a fixed position of nodes

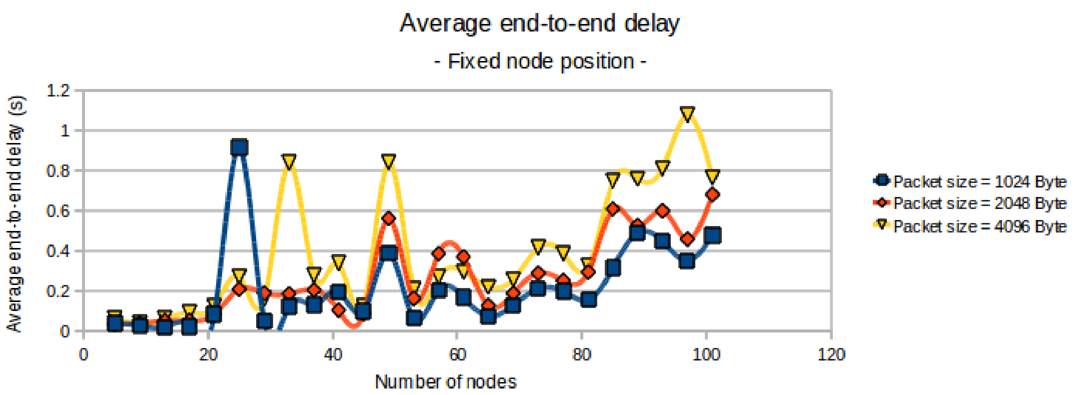

Figure 5. ETD for AODV protocol at the varying packet size and a fixed position of nodes

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If a node is moved to a random position with the certain maximum speed, the result can be explained from a chart in Figure 6andFigure 7, each are for PDF and ETD variables. The Figure 6 shows that more fast a node move, more packet will be received well.Only the first three data showing the maximum speed of 4 m/s produce the PDF less or equal to the PDF produced by the lower speed (2 m/s or fixed position).

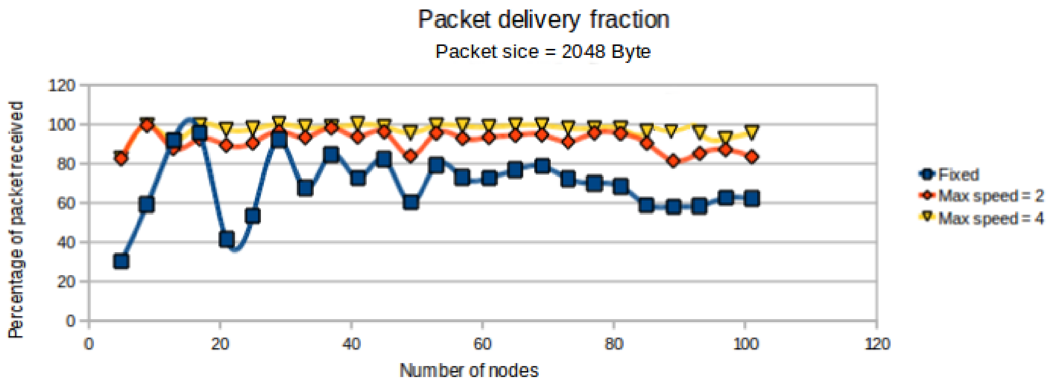

Figure 6. PDF for AODV protocol with varying speed and the fixed packet size of 2048 Byte

On the other hand, Figure 7 shows that the maximum average delay time for the experiment is 1 second.

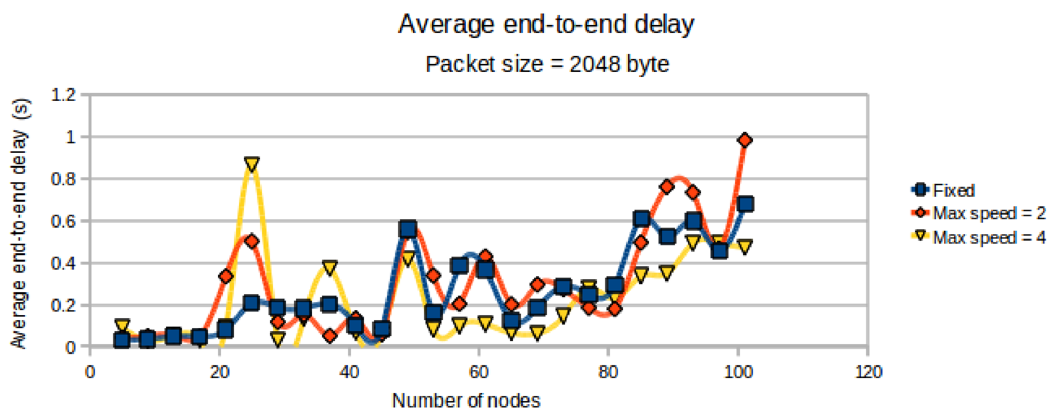

Figure 7. ETD for AODV protocol at varying speed and the fixed packet size of 2048 Byte

DSDV Protocol

For DSDV protocol, a chart that shows an effect of increasing number of nodes to the packet lost is shown inFigure 8. The same trend with AODV is shown in that chart with a packet lost is tend to be larger. For the number of nodes larger than 50, the PDF is about 30% - 90%. This value is less than the value produced by AODV protocol (Figure 4).

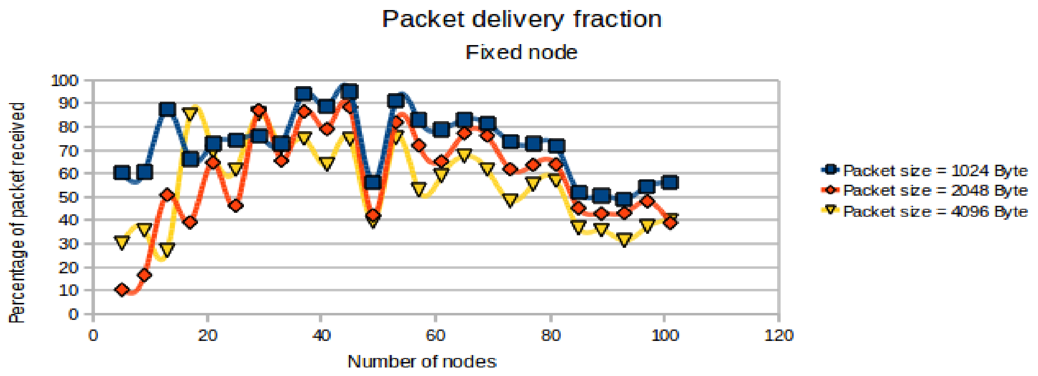

Figure 8. PDF for DSDV protocol at varying packet size and a fixed position of nodes

The next is a delay time for a fixed position of nodes. Figure 9shows that the larger the packet size, the larger the delay time. However, this trend is clearly shown where the number of mobiles nodes are larger than 60.The largest ETD in the experiment is around 1.8 seconds. This value is larger compare to the same experiment using the AODV protocol (Figure 5).

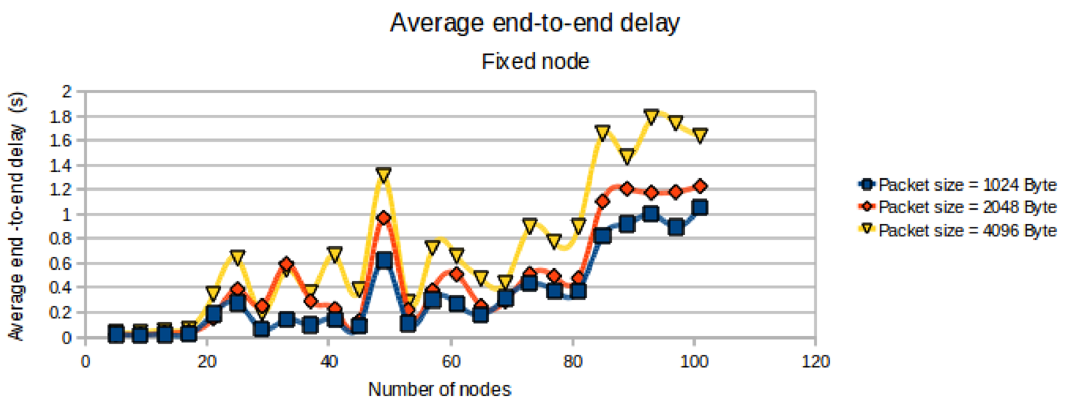

Figure 9. ETD for DSDV protocol at varying packet size and a fixed position of nodes

After that, the effects of node mobility with a certain of a maximum speed to the parameter PDF and ETD are shown in Figure 10 andFigure 11. For a PDF factor, Figure 10 shows that there are also three data from this experiment that produce packet fraction delivery of the maximum speed 4 m/s less or than the packet delivery fraction for the lower speed (2 m/s or fixed). However, from the maximum speed of 2 m/s produce the lower packet delivery fraction compared to the same experiment using the AODV protocol (Figure 6).

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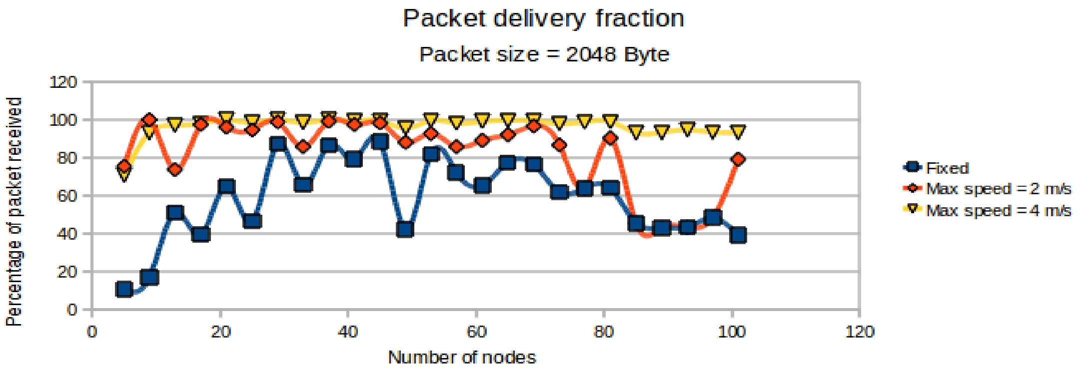

Figure 10. PDF for DSDV protocol at varying speed and a fixed packet size of 2048 Byte

Figure 11 shows that the maximum average delay time for this experiment is about 1.45 seconds, which is larger than the same experiment using the AODV protocol (Figure 7).

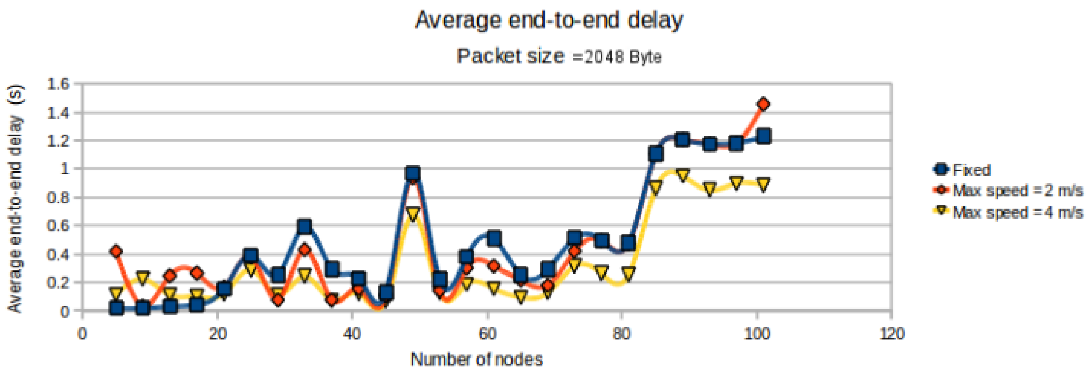

Figure 11. ETD for DSDV protocol at varying speed and a fixed packet size of 2048 Byte

CONCLUSION

From the previous section, we can conclude that AODV protocol shows better performance compared to DSDV protocol. From the perspective of Then, AODV should be prefered either in the fixed position scenario or even in the mobile nodes requirements.

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REFERENCES

1. J. MacFarlane, O. Payton, A. Keatley, G. Scott, H. Pullin, R. Crane, M. Smilion, I. Popescu, V. Curlea, and T. Scott, “Lightweight aerial vehicles for monitoring, assessment and mapping of radiation anomalies,” Journal of Environmental Radioactivity, vol. 136, pp. 127 – 130, 2014.
2. L. E. Quispe and L. M. Galan, “Behavior of ad hoc routing protocols, analyzed for emergency and rescue scenarios, on a real urban area,” Expert Systems with Applications, vol. 41, no. 5, pp. 2565 – 2573, 2014.
3. Ö. Kafalı, S. Bromuri, M. Sindlar, T. van der Weide, E. Aguilar Pelaez, U. Schaechtle, B. Alves, D. Zufferey, E. Rodriguez-Villegas, M. I. Schumacher, et al., “Commodity12: A smart e-health environment for diabetes management,” Journal of Ambient Intelligence and Smart Environments, vol. 5, no. 5, pp. 479–502, 2013.

ISSN: 2355-7524

4. V. Vujović and M. Maksimović, "Raspberry pi as a sensor web node for home automation," Computers & Electrical Engineering, vol. 44, pp. 153 – 171, 2015.
5. S. Mohapatra and P. Kanungo, "Performance analysis of aodv, dsr, olsr and dsdv routing protocols using ns2 simulator," Procedia Engineering, vol. 30, pp. 69 – 76, 2012.
6. S. Tyagi, S. Som, and Q. Rana, "A reliability based variant of aodv in manets: Proposal, analysis and comparison," Procedia Computer Science, vol. 79, pp. 903 – 911, 2016.
7. M. Rmayti, R. Khatoun, Y. Begriche, L. Khoukhi, and D. Gaiti, "A stochastic approach for packet dropping attacks detection in mobile ad hoc networks," Computer Networks, vol. 121, pp. 53 – 64, 2017.
8. B. K. Saraswat, M. Bhardwaj, and A. Pathak, "Optimum experimental results of aodv, dsdv & dsr routing protocol in grid environment," Procedia Computer Science, vol. 57, pp. 1359 – 1366, 2015.
9. M. B. Channappagoudar and P. Venkataram, "Performance evaluation of mobile agent based resource management protocol for MANETs," Ad Hoc Networks, vol. 36, Part 1, pp. 308 – 320, 2016.
10. B. Rashid and M. H. Rehmani, "Applications of wireless sensor networks for urban areas: A survey," Journal of Network and Computer Applications, vol. 60, pp. 192 – 219, 2016.
11. A. Chavan, D. Kurule, and P. Dere, "Performance analysis of aodv and dsdv routing protocol in manet and modifications in aodv against black hole attack," Procedia Computer Science, vol. 79, pp. 835 – 844, 2016.
12. P. Patel, R. Bansode, and B. Nemade, "Performance evaluation of manet network parameters using aodv protocol for heaack enhancement," Procedia Computer Science, vol. 79, pp. 932 – 939, 2016.
13. M. Swathi, B. Pravallika, and N. Muralidhar, "Implementing and comparison of MANET routing protocols using ns2," International Journal of Emerging Technology and Advanced Engineering, vol. 4, no. 2, pp. 192-200, 2014.