International Journal of Engineering and Information Systems (IJEAIS)
ISSN: 2643-640X
Vol. 4, Issue 6, June – 2020, Pages: 69-76

Evaluation of Resource Management Support Software for NEMO in-Vehicle of IPv6 Network

Adeniji Oluwashola David[1] and Sabira.Khatu[2]

[1]Department of Computer Science, Faculty of Science, University of Ibadan, Ibadan, Nigeria, University of Ibadan, Ibadan, Nigeria
sholaniji@yahoo.com, od.adeniji@ui.edu.ng
[2]Department of computer and communication systems Engineering, Universiti Putra Malaysia, Serdang, Selangor Darul Ehsan, Malaysia.
sabira@eng.upm.edu.my.

Abstract*—The Always Best Connected (ABC) is a complex trend in 4G wireless and mobile communication systems. The ABC solutions have been providing multi-access to one terminal that moves between different networks. The end user has more than one interface that is capable to connect to the network. However, Vehicle in IPv6 network may consist of interfaces such as cellular phone, notebook computer, PDAs, cameras, game devices and Bluetooth technology. The complexity of the network during connectivity of multiple terminals may leads to Fault-Tolerance/Redundancy, Load-Sharing and Policy based routing protocol. The non-availability of the interface by users during deployment poses the major challenges with IPv6 in-vehicle network. Fault-Tolerance and Redundancy are critical when the Mobile Network maintains at least one connection to the Internet, connectivity for all mobile nodes is guaranteed. Policy based routing protocol for mobility in IPv6 network was developed in the study. The Policy based routing protocol was used to investigate on how to provide available interface for an uninterrupted services for resource management. The study provides the evaluation of the developed solution to manage IPv6 in-vehicle networks. Network Simulator using NS-2 with mobiiWan patch was used in conducting the experiment. Performance evaluation of end to end delay and average end to end delay was measured during the simulation.*

Keywords: Network Mobility, Mobile IPv6, Policy based Routing Protocol, end to end delay

1. INTRODUCTION

The standard in mobility management is the mobile IP. To support IP mobility, Internet Engineering Task Force (IETF) has proposed Mobile IP based on IPv4 and IPv6 to solve most of the problems facing mobility issues. If a mobile node can maintain its IP address while moving, it makes the movement transparent to the application, and then mobility becomes invisible. The basic requirement for a mobile host is the ability to change its point of attachment to a network without break of communication.. From a network layer deployment, a user is not mobile if the same link is used, regardless of location. It is also possible that several different bearers are available to a link layer interface at the same time. The entity within the home network that performs the mobility management functions on behalf of the mobile node is called the Home Agent (HA). Foreign Agent (FA) is named as the entity in the foreign network which helps the mobile node with the mobility management functions. However, in Mobile IPv6, FA is not used any more since a mobile node itself could perform the mobility management functions. During mobility FA/MN has to register itself onto a HA by sending a Binding Update message, so that the HA could track the location of the mobile node and manage the delivery of packets [1, 2]. The delivery of the packet could affect resources in used if the interfaces are not available. To solve the problem of non-availability of interface. Investigation into critical problem such as Fault-Tolerance, Redundancy, Load-Sharing and Policy routing protocol must be addressed. This paper is organized as follows: Section one present the introduction, section two methodology while section three explain results from the experiment The conclusion and recommendation of the study was provided in section four.

2. Related Works

Investigation into Network Mobility and Mobile IPv6 are presented in this section. The main features of Network Mobility and Mobile IPv6 in the mobility management of IPv6 in-vehicle networks was enumerated.

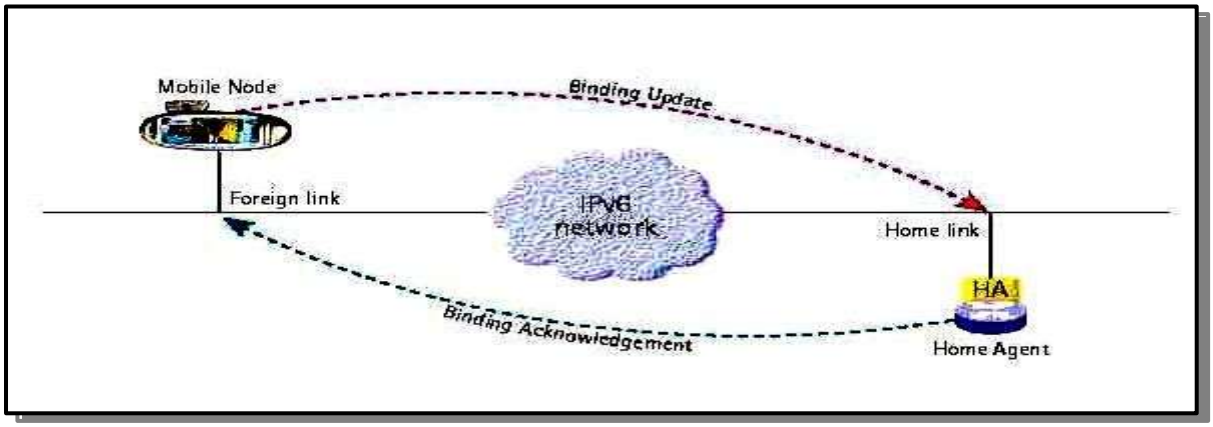
A. Network Mobility

Network Mobility defines the situation of a router connecting to an entire network on the Internet dynamically changing its point of attachment. The connections of some of the nodes inside the network to the Internet are also influenced by their movement. The connection of mobile network to the Internet is usually through one or more MR. The node behind are referred to as Mobile Network Nodes. Some instances of mobile networks include PAN's or a Personal Area Network. These nodes could be Local Fixed Nodes or visiting mobile node. NEMO Basic Support provides some mechanisms that allow MN to remain connected to the Internet and continuously reachable at all times. Any vehicle that has adopted "Intelligent Transportation Systems applications must adopt NEMO requirement. [3,4]. The vehicle contains the computer that runs the whole system. Mobile networks do not actually change their attachment to the internet, they change the position in the topology in relation to the global Internet. Since no two

networks are the same, network mobility has adapted to the different levels of complexity. The simplest case of a network could contain a mobile router and a host. A very complex case would include thousands of hosts, mobile routers each at different levels.

B. Mobile IPv6

In MIPv6, packets can be forwarded without tunneling, as the source address is always the care-of address. In MIPv4, the Home Agent (HA) must be involved in the set-up of optimized routes. In MIPv6, the MN can initiate an optimized route to a corresponding node (CH) directly (without involving the HA), and therefore more quickly and efficiently [5,6]. The major benefit of Mobile IPv6 is that even though the MN changes locations and addresses, the existing connections through which the MN is communicating are maintained. To accomplish this, connections to MNs are made with a specific address that is always assigned to the MN, and through which the MN is always reachable. Mobile IPv6 provides Transport layer connection survivability when a node moves from one link to another by performing address maintenance for MNs at the Internet layer. MIPv6 with it mobile node performs binding registration by sending a "Binding Update" message to the Home Agent. Binding Update is encoded as an option to be carried within a Destination Options Header of IPv6 [7,8]. The Home Agent replies to the mobile node by returning a "Binding Acknowledgement" message. Like the Binding Update, Binding Acknowledgment is encoded as an option to be carried within a Destination Options Header of IPv6 [9,10] as depicted in figure 2.



Mobile IPv6 also provides support for multiple Home Agents, and the reconfiguration of the home network. A mechanism, known as "dynamic Home Agent address discovery" allows a MN to dynamically discover the IP address of a Home Agent on its home link, even when the MN is away from home. Mobile nodes can also learn new information about home subnet prefixes through the "prefix discovery" mechanism [11,12] as shown in figure 3.

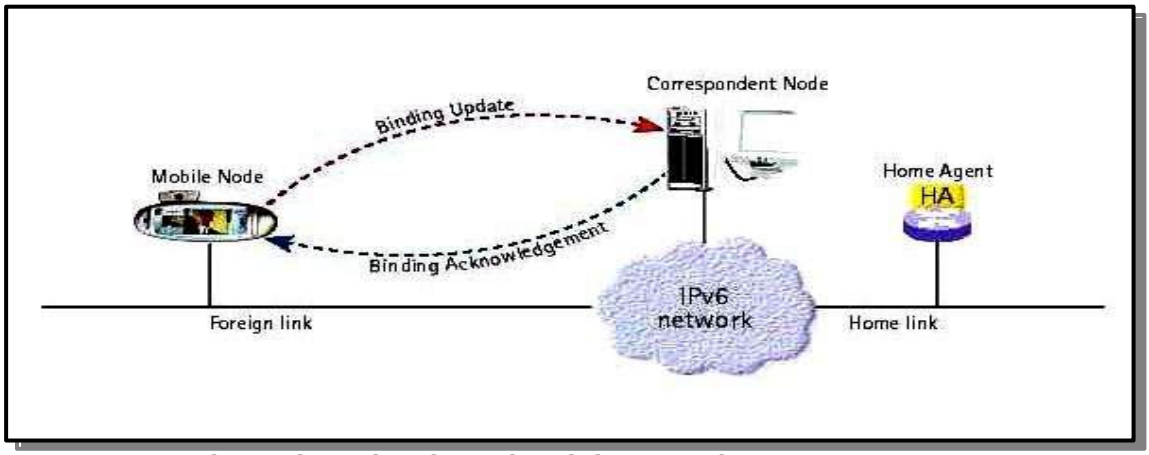


Figure 3: Binding Update and Binding Acknowledgement with CN

C: Policy Based Routing Protocol

The main interest in network policies is to manage and control the quality of service (QoS) experienced by networked applications and users by configuring network elements using policy rules. The set of rule define the choices in the behavior of a system. The

set of rule also define the policies to be developed. To develop set of policies attributes are considered. Policy Decision Point (PDP), Policy Enforcement Point (PEP), Policy Repository and Interface Selection are the attributes that defined policies. The interface selection system is based on the types of entities, action, policy and mechanism to be deployed. Actions specify the interfaces to be used for connections on account of entity's requirements. Policy governs the actions of an entity Entities define actions. An entity may be a user, peer node or 3rd party, e.g., operator. **Policy Repository** manage the traffic of a mobile network which are stored in policy repository. **Policy Enforcement** enforces the policy for example by permitting/forbidding requests or allocating packets from a connection to a particular queue . Policy enforcement involves the PEP applying actions according to the PDP's decision and based on current network conditions. IP address are required to define the source and destination of packet available at a time of the day for different users based on the application. The routing protocol depend on the intended application, this may or may not be limited. However, some important applications such as voice-over IP runs over the user datagram protocol (UDP) [13, 14]. The transmission control protocol (TCP) requires that the receiver acknowledge information during handshake process in bytes which keeps track of the round-trip delays experienced by the packets on connection. This round
trip delays are tracked by a time-stamp option that is carried in the TCP header for packets and acknowledgement. Table 1 present the attribute for the interface selection that was used during the simulation.The internet service driven network is a new approach to the provision of network computing that concentrates on the services you want to provide as adopted in [15] .However ***there are no adequate provision for quality of service (QoS) in OpenFlow using Flow Label to reduce bits required as a field to match packets in internet protocol six (IPv6)[16].***However, the resource management of Multihoming in nested mobile network raises new issues in the host mobility of ipv6 network.in [17]. Different methods have been employed to secure and protect the shared and sensitive data. *However*, *the* significant roles of encryption algorithms are numerous and essential in information security[18] ***in*** Comparative Study of Symmetric Cryptography Mechanism . The prediction of incoming attacks is achieved in a timely manner which enables security professionals to install defense systems in order to reduce the possibility of such attacks in ***Zero Day Attack Prediction with Parameter Setting Using Bi Direction Recurrent Neural Network in Cyber Security.*** [19].Further information on an intellient spam-scammer filter mechanism using bayesian techniques [20] was reviewed.It is against this background, that various research has been carried out with the aim of solving detection and preventing such intrusive attacks[21] [22]. Also there is a need for scalable and energy-efficient routing, data gathering and aggregation protocols in these WSN environments in [23]It is of very low standard and quality, little or no integrity, very easy to forge in,[24].*The tradeoff between the two protocols can provide a significant impact on the networks.in [25]*.However, analyzing the qualitative usage of accounting software for short medium services is the major problem in an economic system.[26]. A framework on Big Data was developed to extract knowledge based on the activities of the insurgency[27].A biometric attendance management system was developed to verify the workload performance impact on teachers and students.

Table1: Policy Attribute on Interface Selection

Event	Comment on Event	Action on Event
Available Interface	The highest priority matching is MR	Select the MR: √
Signal Strength	Signal strength drop below threshold	Reselect MR:√
Congestion Control	Delay on MAC, longer threshold	Select /Remove:√
Energy Backup	Low Backup	No Binding Update

The above table 1 shows the event procedure type, comment on the event based on priority and the action to taken by users depending on the application in use. The available interface must be identified, signal strength must be identified, and congestion control and energy backup will determine the procedure type. The selection of event may also depend on whether characteristic of the interface such as low or high signal strength, delay on MAC with longer threshold and backup properties. Users can decide which actions to take either accept or remove any event based on priority. The outbound traffic control is the same as mobile mode case, but the inbound traffic control is different as shown in table 2.

Table2: Policy Attribute on Traffic

Event Procedure Type	Comment on Event	Action on Event
Available Interface	The highest priority matching is MR	Select the MR: √
Signal Strength	Signal strength drop below threshold	Reselect MR:√
Inbound Traffic	The interface is turn ON	Select the HA: √
Out bound Traffic	The interface is turn ON	Select the HA: √

The simulation parameter and the values used during the model are presented in the table 3 below.

Table 3: Simulation Parameters and Values of the Network Model.

Simulation Parameters	Simulation Values
Propagation time of wired link	1.8ms
Propagation delay	100Mbps
Simulation area	800 x 800 m
Packet size	1000k, 500k
Packet rate	100k
CBR source	2 for UDP/TCP
Simulation time	100sec

D : Network Modeling of the Framework

The model was constructed using some defined information such as Information for Policy attribute and Policy Information Transfer Protocol as shown in table 1 and 2. The policy attribute consist of some functional component such as, policy decision point (PDP), policy enforcement point (PEP), and policy respiratory. The Model assume a train network scenario which comprises of corresponding node (CN), intermediate router (R), home agent (HA), four base stations (BS), mobile router (MR) and mobile network node (MNN).The base stations function is to connect the wired topology to the wireless nodes with routing functionality by the exchange of routing information with other nodes which are routed to the correct destination. As the mobile node moved from its home link and to the foreign links associated with BS-1, BS-2 and BS-4 in turn, three binding updates would take place during the movement. When the train moves from it HA (domain) to another network ,the train will register with the network to obtain the care of address (CoA).Once the address is obtained, the registration process will begain between the MR and HA.The result of the registration will create a bi-directional tunnel. Any packet destined to the MR or MNNs will be forwarded by the HA through the bi-directional tunnel. The process continues whenever the train moves from one access domain to another. The figure 4 below present the topology for the model.

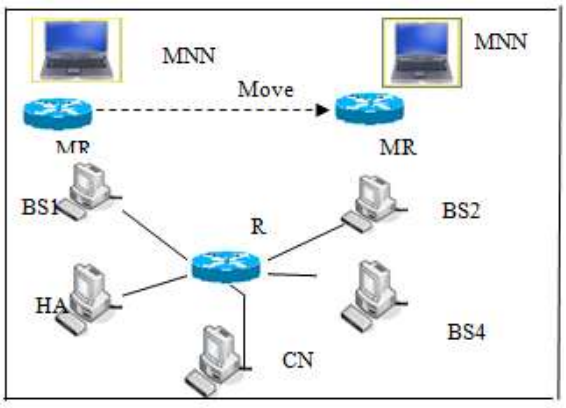


Fig 4: Simulation Topology

The steps taking during the experiment involve configuring and defining parameters options such as the channel type, the propagation loss model, antenna type in the script as shown below:

Base station configuration setup:

```
#############################################################
proc def_bs_config { } {
    global ns topo
    $ns node-config \
      -mipv6 ON \
          -mipagent BS \
          -mobileIP ON \

          -wiredRouting ON \


       -adhocRouting Network \
              -llType LL \
          -macType Mac/802_11 \
       -ifqType Queue/DropTail/PriQueue \
              -ifqLen 50 \
       -antType Antenna/OmniAntenna \
     -propType Propagation/TwoRayGround \
          -phyType Phy/WirelessPhy \
     -channelType Channel/WirelessChannel \
              -topoInstance $topo \
              -agentTrace ON \
              }
```

The addressing structure is built up hierarchically, dividing the topology into domains, clusters and nodes.

```
#####################################################################
# set up for hierarchical routing
#####################################################################
                Call node-config
                $ ns node-config \
              -address Type hierarchical \
                -agent Trace ON \
                -router Trace ON
              # Set NS Addressing
AddrParams set domain_num_ 2        # number of domains
  AddrParams set cluster_num_ {1 5} # number of clusters in each domain
  AddrParams set nodes_num_ {1 1 2 1 2 1}# number of nodes in each cluster The line “$ns_ node-config -address Type hierarchical” is used to configure the node object to have address type as Hierarchical. Next the topology hierarchy is defined.Number of domains in this topology is 2. Number of clusters in each of these domains is defined as "1 5" which indicates the first domain to have 1 clusters, the second to have 5. The next line defines the number of nodes in each of these clusters. The next step is to set up tracing for the simulation. The traces are written into the output file defined here as “out.tr”. The next line sets up NAM traces that will be written into the file called “out.nam”.The UDP agent is created and is attached to CBR Traffic generator to the UDP agent. CBR stands for 'constant bit rate'. The mobile node is defined as the destination of the traffic. “$ns_ at 40.0 "$src start"” will make the scheduler call for a start member function of the CBR traffic source object, which starts the CBR to transmit the data.
```

3: Result and Discussion

The result of the registration that created a bi- directional tunnel during the experiment is shown in figure 5 below. Any packet destined to the MR or MNN will be forwarded to HA through the bi- directional tunnel.

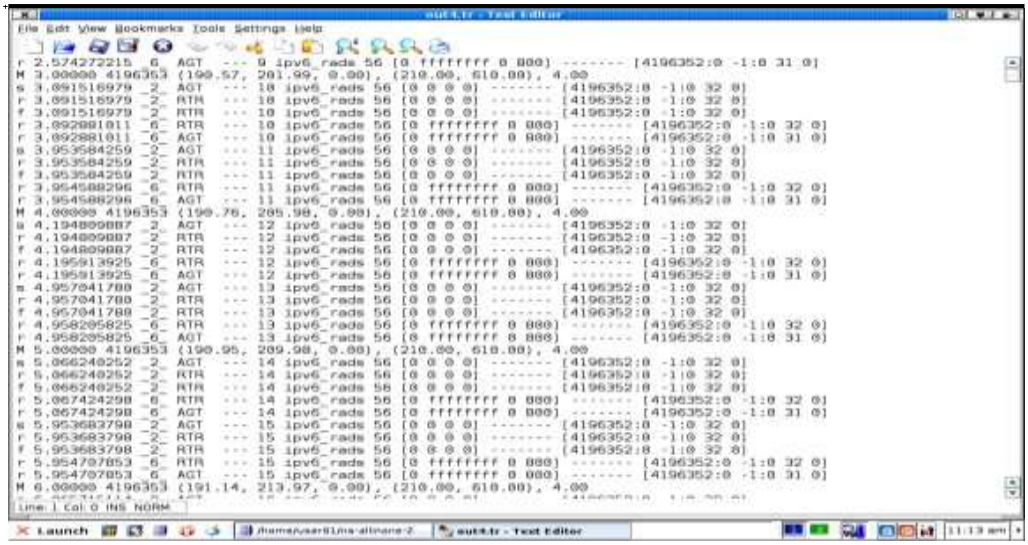


Fig 5: Trace on bidirectional registration of MR and HA.

Considering NEMO solution between the time duration of 50s to 52s there is a packet delay of 0.016s to 0.012s as shown in figure 5.1. At first the delay increases then suddenly decreases this could be the "pinball problem" in NEMO and also from investigation it could be the procedure for the handover process from one base station to the other which may account in breakdown of the internet backbone. But with the proposed solution it has significantly reduces the end-end packet delay to 0.005s at 51s time.

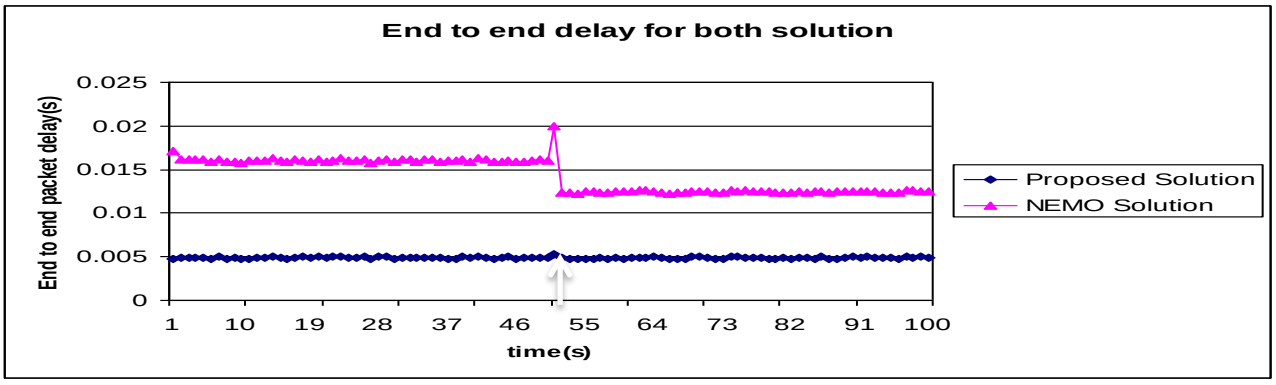


Figure 5.1: End-End Packet Delay

From observation at 51s the maximum end to end packet delay is 0.020s for NEMO solution, while for the proposed solution the packet delay is 0.005s. This signifies that the performance o f the proposed solution is 75% more efficient than NEMO solution in minimizing packet delay.

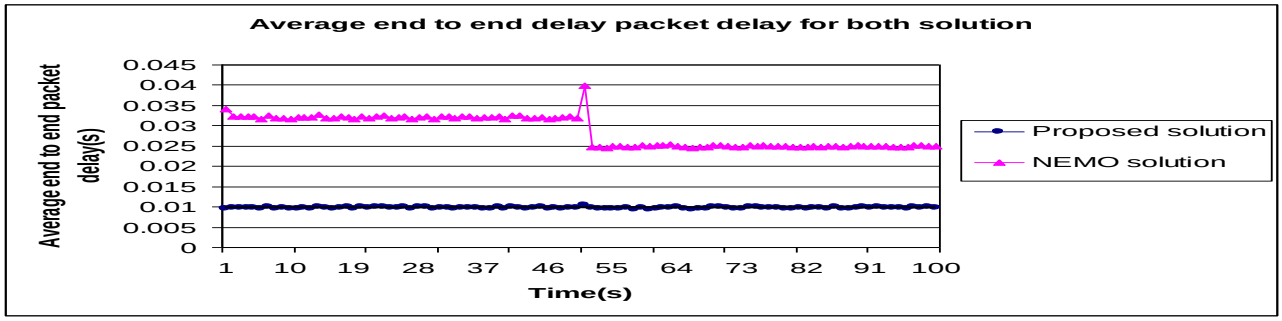


Figure 5.2:Average end-to-end packet delay for NEMO and Proposed solutions

In the figure above the maximum packet delay for NEMO solution was 0.040s against 0.011s for the proposed solution at the same simulation time of 51s. This signifies that the proposed solution has Globally the proposed solution provides a gain of147.5 %(75%, 72.5%) in terms of end to end packet delay. The transmission time of each packet is also reduced due to reduced encapsulation of packets.

5. Conclusion

In this paper, the study demonstrated the impact of end-end delay and average end-end delay of resource management software for NEMO in vehicle IPv6 network. The significant of complex management of some critical indicator was examined. Globally the proposed solution provides a gain of 147.5% there by avoiding degradation of internet backbone of IPv6 in vehicle network. However the implementation of attribute that define policies such as PDP, PEP, policy repository and interface selection are of great advantage in managing resources of NEMO in vehicle IPv6 network.

REFERENCES

[1] Tsirtsis, G. Soliman, H., Montavont, N., Giaretta, G., Kuladinithi, K., Flow Bindings in Mobile IPv6 and Network Mobility (NEMO) Basic Support, , RFC 6089. 2011

[2] Qiu, Y., .Zhao, F., Koodli, R., . Mobile IPv6 Location Privacy Solution, ISSN: 2070-1721 RFC 5726. 2010

[3] Petander, H., Perera, E., LAN, K.C., Seneviratne, A., Measuring and improving the performance of network mobility management in IPv6 networks, IEEE J. Sel. Areas Communication ,24(9), PP.1671–1681.2006

[4] R.Yavatkar, D.Pendarakis and R.Guerin, "A Framework for Policy-based Admission Control", RFC 2753. 2013,

[5] J. Strassner, G. Karagiannis, B.Quinn, S.Herzog, A.Huynh, M.Carlson, J.Perry and S.Waldbusser,) "Terminology for Policy-Based Management, RFC 3198, (2018

[6] Thierry Ernest Mobiwan A NS2.1b6 simulation platform for mobile IPv6 in wide Area Network.2012

[7] Tsirtsis, G. Soliman, H., Montavont, N., Giaretta, G., Kuladinithi, K., (2011) Flow Bindings in Mobile IPv6 and Network Mobility (NEMO) Basic Support, RFC 6089.

[8] Krishnan. S., Woodyatt, J.H., Kline, E., Hoagland, J., An uniform format for IPv6 extension headers *draft- krishnan-ipv6-exthdr-05, RFC BCP 79.*2012.

[9] S. Cho, J. Na, C. Kim, S. Lee, H. Kang, and C. Koo, "Neighbor MR Authentication and Registration Mechanism in Multihomed Mobile Networks," IETF Internet Draft, draft.2014.

[10] Atiquzzaman, M., Shahriar, A.Z.M., Ivancic, W., . Route optimization in network mobility: Solutions, classification, comparison, and future research directions, *IEEE Communications Surveys & Tutorials, Vol.12, No.1, pp.24-38.*2012

[11] Barker, K., Bi, J., Deng, H., Xu, M., Shi, F., & Hu, G., "The security implications of IPv6. Network Security. A General framework of source address validation and traceback for IPv4/IPv6 transition scenarios. *IETF Internet standard Draft. Vol 6, 5-9.* 2013.

[12] Dutta N., Saha IS Misra, Pokhrel R., Mrinal, K., Performance Analysis of Multilayer MIPv6 Architecture through Experimental Test bed, *Journal of Network, Vol 7, pp 1682-1691,* 2014.

[13] Mazlan, M. H., . Testbed development for mobile ipv6 with network mobility (NEMO). Universiti Teknologi Malaysia ,*WorldCat , OCLC Number: 960344283.* 2011

[14].Tsirtsis, G. Soliman, H., Montavont, N., Giaretta, G., Kuladinithi, K., . Flow Bindings in Mobile IPv6 and Network Mobility (NEMO) Basic Support *RFC 6089.*(2011)

*[15]***.** Adeniji, S.D, Khatun, S, Borhan, MA,Raja, RSA , "A design proposer on policyframework in IPV6 network". 2008 IEEE International Symposium on Information Technology.Vol 4,pp 1-6 (2008)

[16] Olabisi,A. A., Adeniji,, O. D. Abeng Enangha " A Comparative Analysis of Latency, Jitter and Bandwidth of IPv6 Packets Using Flow Labels in Open Flow Switch in Software Defined Network" Afr. J. MIS, Vol.1, Issue 3, pp. 30-36. (2019)

[17]. Adeniji, S.D , Khatun, S, Raja, RSA, Borhan MA .'Design and analysis of resource management support software for multihoming in vehicle of IPv6 Network. Proceedings of the Fifth IASTED International Conference.Vol 607,issue 089.pp 13., 2008.

[18].Logunleko K.B., Adeniji. O.D., Logunleko A.M, "A Comparative Study of Symmetric Cryptography Mechanism on DES, AES and EB64 for Information Security". International Journal of Scientific Research in Computer Science and Engineering Vol.8, Issue.1, pp.45-51, 2020.

[19]. Adeniji O.d., Olatunji O.O . "*Zero Day Attack Prediction with Parameter Setting Using Bi Direction Recurrent Neural Network in Cyber Security".*International Journal of Computer Science and Information Security (IJCSIS), Vol. 18, No. 3,pp 111-118 , 2020

[20].Adeniji O. D , Olubukola Adigun, Omowumi O Adeyemo " An intelligent spam-scammer filter mechanism using bayesian techniques"International Journal of Computer Science and Information Security (IJCSIS), Vol. 10, No. 3 pp 126, 2012.
[21]Ukam, J.J, Adeniji O.D."Performance Evaluation of Error Rate in Immune Inspired Concepts with Neural Network for Intrusion Detection in Cybersecurity.**International Journal of Advanced Research in Computer and Communication Engineering** Vol. 9, Issue 6,pp 16-22 , 2020.
[22]. Adeniji O.D. & Ukam, J.J " Immune Inspired Concepts Using Neural Network for Intrusion Detection in Cybersecurity" Proceedings of the 20th iSTEAMS Multidisciplinary Trans-Atlantic GoingGlobal Conference KEAN University, New Jersey, USA Pp 119-126, 2019.
[23].Ojoawo A.O & Adeniji O.D. " Energy Efficient Hierarchical Cluster Head Election Using Exponential Decay Function Prediction." International Journal of Wireless & Mobile Networks (IJWMN) Vol. 10, No. 5, 2018.
[24] Eze Chika Victor, Adeniji Oluwashola David, "Character Proximity For RFID Smart Certificate System: A Revolutionary Security Measure To Curb Forgery Menace"INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH,pp. 66-70. , 2014.
[25].Adeniji O. D, Osofisan Adenike ***Route Optimization in MIPv6 Experimental Test bed for Network Mobility: Tradeoff Analysis and Evaluation.*** International Journal of Computer Science and Information Security (IJCSIS), Vol. 18, No. 5,pp 19-28 2020.
[26]Adelusi Bamidele Samuel , Adeniji Oluwashola David Analyzing the Usage of Accounting Software for Short Medium Services (SMS) using Panel Data to improve Business competitiveness of Microfinance. Journal of Digital Innovations & Contemp Res. In Sc., Eng & Tech. Vol. 7, No. 1. Pp 95-110 .2019.
[27].Adeniji Oluwashola David. .Big Data: A Computing Model for Knowledge Extraction on Insurgency Management.International Conference on Information and Communication Technology and Its Applications,PP 52-55..2016.
[28]I.R. Idowu & O.D. Adeniji Performance Evaluation and Analysis of Biometric Workload Attendance Management System Journal of Digital Innovations & Contemp Res. In Sc., Eng & Tech. Vol. 6, No. 2. Pp 47-56 , 2018.