Multi Boundary Mobility Organization with SIP and MIP (To Avoid Handoff Delay)

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Abstract

In this paper we provide an experiment analysis of MIMM (Multi Interface Mobility Management) demonstrated in a heterogeneous network involving 802.11b and CDMA access technologies. Wireless LAN (WLAN) or Wi-Fi is becoming prevalent means of access to the wireless internet. Especially the advent of the hotspot service brings the roaming user the benefit of receiving broadband internet access while outside one's enterprise network. But the coverage of the hotspot in public area is still limited and may not be available everywhere. On the other hand 2.5G/3G cellular system provides wide area connectivity to the roaming users. Therefore, the scenario for seamless communication involving movement between cellular and hotspot is becoming realistic these days. Because of lack of available solutions to take care of such mobility scenarios, switching among multi-interface causes several problems as it involves interaction between physical layer, network layer and the application layer. MIMM (Multi-Interface Mobility Management) is a module that helps to realize the seamless interface switching involving 802.11b and CDMA networks. It provides the interaction between cross layers while providing the mobility management solution.
Keywords: SIP, MIP, LAN, CDMA, Wireless

I. INTRODUCTION

In this paper, we demonstrate the capability of MIMM for supporting the seamless interface switch between WLAN and WAN(i.e. cellular data system).The situation 'make before break' was realized and examined, since those two interfaces can work independently and MIMM or the switching module can have enough time to prepare the handoff before it happens. Through the experiment we demonstrate that seamless handoff for voice and video service is achieved when the interface-switch occurs. The discussion below describes how the handoff takes place.

II. MIMM ARCHITECTURE

This section provides an architectural overview of how MIMM module can be utilized to take care of layer 2 and layer 3 handoff in a heterogeneous networks involving Bluetooth, 802.11b and CDMA access technologies. In a practical scenario the mobile may move between two access points belonging to the same subnet or between subnets belonging to two different domains.

This system configuration of WAN-WLAN handoff that we have provided. The mobile node(MN) is equipped 802.11b PCMCIA card, and 1X-RTT PCMCIA card, so that it can use both 3G cellular system and the wireless LAN to provide IP communication. Besides the 3G cellular network, there are two LANs, one is for home network and the other one is used as a visiting network for MN. The mobile node moves between one visiting network B(802.11b) to another visiting network C(cellular) and comes back to the home network. The correspondent host (CH) can be located in the home network or in any other network.CH sends video or audio stream to the MN. We used vic and rat as the real-time application for video or audio source respectively. MIMM module on the mobile node MN checks the Signal-Noise ratio on 802.11b connection and if it goes below the threshold, MIMM decides to use 1XRTT connection and otherwise it selects to use 802.11bconnection. 802.11b card used on MN has the external antenna with attenuator. By changing the attenuation level, Signal-Noise ratio of 802.11b connection is changed, so that MN does handoff between 802.11b and 1XRTT without physical movement. In order to avoid the hysteresis the handoff transition takes place in two phases. At a certain Signal-Noise ratio S1, the mobile begins the preparation to connect to CDMA network in the background and as the Signal-Noise ratio goes below another threshold S2, the mobile makes the CDMA interface as the primary one and communicates using that interface.

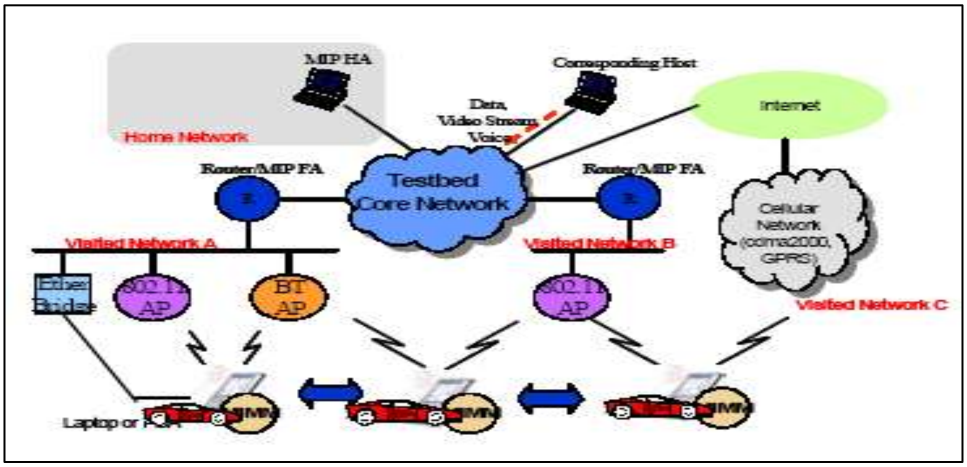

Fig. 1: System Configuration

A. MIMM Module

MIMM module manages the mobility involving more than one physical interface or communication media. In this experiment, MIMM behaves as an intelligent network interface switch in L3 layer. Policy decision that helps trigger the network handover is implemented in MIMM. Once MIMM decides to change the active interface, it takes care of the routing table and invokes the registration or another mobility management process of Mobile IP or SIP mobility. In this particular experiment, IP address of 802.11b connection on MN was static and assigned from the beginning, thus time due to IP address acquisition is not included, but in reality it will include the time associated with the IP address acquisition such as DHCP.1XRTT connection is carried by PPP from MN's PCMCIA interface to the PDSN (Packet Data Service Node). IP address on MN is assigned through PPP, since we used "Simple IP" service and used mobile IP in collocated-Address mode. Because of timeout, PPP connection may get dropped sometimes and it that case MIMM needs to start setting up PPP connection so as to enable the switching of the interface. During the new PPP setup, assigned IP address may or may not change at that time, since it depends upon the NAS it connects to and the policy setup within a NAS.

A mobile that is not equipped with MIMM module prepares the secondary interface after the connection to the primary interface is lost completely. In these scenarios, when the mobility module decides to switch interface, it cannot use the former interface anymore and suddenly it needs to setup another interface including new SSID, IP address and other networking parameters. These standard handoff mechanisms take excess time during handoff. This type of handoff model is called "break before make" model. When the mobile is equipped with MIMM module, it can always setup the secondary interface when the mobile is still communicating with the first interface. So the setup procedure for each interface was done before switching the interface. Therefore, excess time for configuring the interface doesn't need to be taken into consideration. This specific type of model is called "make before break" model. MIMM module helps the mobile to this type of model. It does so by communicating with a policy engine that helps to switch the active interface. In most cases the MIMM module resides within a mobile, however MIMM module can always be a part of a network entity such as a server at the edge of the network. Based on certain condition of the network such as load in the network it can trigger the switch.

III. EXPERIMENTAL ANALYSIS

In this term we analyze the results of the experiment conducted when MIMM module was used for both SIP - MIP based mobility.

Handoff between WAN-WLAN (CDMA – 802.11b) was demonstrated using both SIP – based mobility management and Mobile IP. These sets of experiments involve the following: voice with MIP, video with MIP, and voice with SIP mobility. In each case, all packets transmitted were analyzed by tcp dump both on MN and CH. For mobile IP, HUT implementation is used as a base. For SIP mobility, SIP user agent developed by Columbia University is modified to support mid – session mobility. Table 1 shows software details.

Table – 1
Software details

OS	Linux version 2.4.12
Rat	Version 3.0 (http://www-mice.cs.ucl.ac.uk/multimedia/software/)
Vic	Version 2.8ucl-1.1.3 (http://www-mice.cs.ucl.ac.uk/multimedia/software/)
Mobile IP	Dynamics by Helsinki University of Technology http://www.cs.hut.fi/Research/Dynamics/
SIP	SIP version 1.51 by Columbia University (http://www.cs.columbia.edu/sip/)

In order to measure the effectiveness of make – before algorithm supplied by MIMM we provide here a sample of results without make – before algorithm being used. Fig 2 clearly indicates that a mobile is subjected to packet loss and handoff delay in a normal handover scenario without the use of MIMM algorithm. This delay is attributed to the fact that a mobile spends some time in getting attached to the new access network, configuring the IP address and sending the binding update to the correspondent host after it loses contact with the old interface. Fig 3 shows SIP and MIP – based signaling as the mobile makes a transition between the heterogeneous networks. These signaling are actually part of the binding updates from the mobile node to the correspondent node, after the mobile's active interface has been changed. This attributes to the part of delay. The increment of RTP sequence numbers at MN. Both voice and video are carried by RTP over UDP over IP. Especially the voice packet flows every 20ms. Then sequence number shall increase periodically and the graph becomes a single smooth and monotonous incremental line in the event of no packet loss.

In case of both Mobile IP and SIP mobility experiments, G.711 codec generated 160 bytes data every 20ms and that includes 12 bytes RTP header, 8 bytes UDP header, and 20 bytes IP header. Furthermore, over PPP link or 802.11b link, 14 bytes Ethernet header was added also. Thus the total number becomes 214 bytes per packet in MAC layer, or 1712 bits. And 1712 bits every 20ms converts to 85.6kbps line speed. The size of Mobile IP message control packet was around 100 b/message, while SIP INVITE was nearly 500 b/message, this takes 40ms to be carried over 100kbps link. These figures show that the packet loss at MN during the handoff is fairly small number or no packet loss most of the times, thus providing almost smooth handoff experience. In case of both Mobile IP and SIP mobility experiments, G.711 codec generated 160 bytes data every 20ms and that includes 12 bytes RTP header, 8 bytes UDP header, and 20 bytes IP header. Furthermore, over PPP link or 802.11b link, 14 bytes Ethernet header was added also. Thus the total number becomes 214 bytes per packet in MAC layer, or 1712 bits. And 1712 bits every 20ms converts to 85.6kbps line speed. The size of Mobile IP message control packet was around 100 b/message, while SIP INVITE was nearly 500 b/message, this takes 40ms to be carried over 100kbps link. These figures show that the packet loss at MN during the handoff is fairly small number or no packet loss most of the times, thus providing almost smooth handoff experience. The packet behavior during handoff is slightly different between the case of handoff from 3G to 802.11b and that from 802.11b to 3G. During the demonstration using MIMM algorithm we experienced smooth and seamless handoff as the mobile made either interface as the active interface during the transition. Fig 3a &3b depict normal protocol sequences during the handoff for SIP mobility and MIP mobility respectively. In case of SIP mobility, MN sends out an INVITE message keeping the same Call-ID but including new IP address of the interface to which MIMM decides to switch. Then, CH replies with 200 OK and waits the other message, ACK, from the MH. After receiving ACK from MH, CH changes the destination IP address of media session. Then MN begins to receive it on the new interface switched by MIMM. Therefore, we analyze the timing closely in Table 3, those are the time between sending INVITE and receiving 200 OK on MN and the time between sending INVITE and receiving the first media packet on the new interface switched by MIMM. The first one can be considered as a time for protocol to exchange the information properly. The second one can be seen as more practical switching time, in which MN waits a packet on the new interface.

In case of mobile IP, MN sends out Registration request (RRQ) with zero life time in order to remove the current binding from HA registration, when MIMM decides to switch interface. Then, MN sends out another RRQ with a certain life time period to register the new IP address which the switched interface has. By receiving this new RRQ, HA replies Registration Reply (RRP) to confirm new registration and begins to forward the media packet to new destination address simultaneously. Between the first RRQ and the second RRQ, MN is considered to be in the de-registration state. HA doesn't forward packet for MN and the media packet destined to the MN's home address is just dismissed in the home network. Table 2 shows, again, two numbers, the time waiting RRP message for the second RRQ after sending first RRQ with zero life time for de-registration and the time waiting a media packet on the new interface after sending the same RRQ as the first one. Comparing the values of Table 2 and Table 3 doesn't make sense so much. Because it depends on implementation and in this experiment transmission delay is so unbalanced in CDMA network. But one interesting result is that 802.11-> cellular handoff using SIP mobility seems to be bit unstable because of associated re-transmission. In the similar situation, MIP succeeds to send the registration almost all the time. It may depend on the length of the registration message.

MIP registration could be short enough message to be carried by the dedicated control channel over the cdma2000 access, whereas SIP Re-INVITE gets delayed because of re-transmission.

Table – 2
Handoff Timing with MIP Mobility

Movement Type	Cellular-802.11b		802.11b-Cellular	
Handoff Trials	#1	#2	#1	#2
RRQ for deregistration --> RRP for new registration	0.56	0.55	0.91	5.22
RRQ for deregistration --> 1st packet on new I/F	0.57	0.58	1.21	5.24
Retransmission				Yes

Table – 3
Handoff Timing with SIP Mobility

Movement type	Cellular-802.11b		802.11b – Cellular	
Handoff Trials	#1	#2	#1	#2
INVITE -> OK	0.12 s	0.12 s	1.32 s	6.64 s
INVITE -> 1st Packet	0.39 s	0.41 s	2.54 s	7.18 s
Re-transmission	None	None	Yes	Yes

The audio sample recorded at the MN using MIMM algorithm. As is observed there is no packet loss during movement between 802.11b networks to cellular network. Gaps shown while within CDMA network is due to the intermittent connection. However there are some out-of-order packets received when the mobile moves from cellular network to 802.11 network audio snapshot of a scenario when the mobile traverses its path back to 802.11b network after switching to CDMA network. Out-of-order packet during its movement back to 802.11 networks is basically caused by the difference in transportation delay between CH-MN through 802.11 and through 3G. It seems that rat (Robust Audio Tool) or vic(Video Conferencing) can work fairly properly under the situation in which the sequence number of the received packet is not in order. By investigating this data with RTP and codec implementation of rat or vic, we may be able to estimate the user experience because of the gap or overlap of packet reception. For example, RTP recommends that the RTP packets can be considered valid if the range of out of order packets is within certain range. Therefore, the overlap and gap are in the range of expected case and don't break anything of the RTP session. And codec can mitigate this kind of fluctuation usually by using play-out buffer at the receiving end.

Procedure for switching from cellular to802.11b finishes quicker than that from 802.11b to cellular. Since the transmission delay between MN and CH or HA is much smaller in case of using 802.11b connection from MN. And the protocol handshake is mostly carried out on the new connection interface to be switched by MIMM. But it may not be necessary in case of "make before break" situation such as carried out in this experiment 802.11b connection can be used for signaling even for switching from 802.11b to cellular. Especially in case of SIP, it doesn't matter which route is chosen for signaling. But it is necessary to have another way to check the availability of media route.

In case of SIP, time for processing consecutive processes on CH or MN seems large. This is the main portion of 120ms of time duration for "INVITE ->200K". This could be attributed to the processing power of the end host and SIP implementation. Although message processing in case of MIP is quick, MN waits around 500ms to send out second RRQ after sending first RRQ or receiving RRP for the first RRQ. It could be the issue of implementation. Another point of investigation for MIP is to see if MN can change the order of sending out RRQ or not. If HA can accept the duplicate binding, MN can send out the RRQ for new registration first so that HA can forward the packet to the new place without dropping any packet. Simultaneous binding or registration at the home agent can take care of this problem.

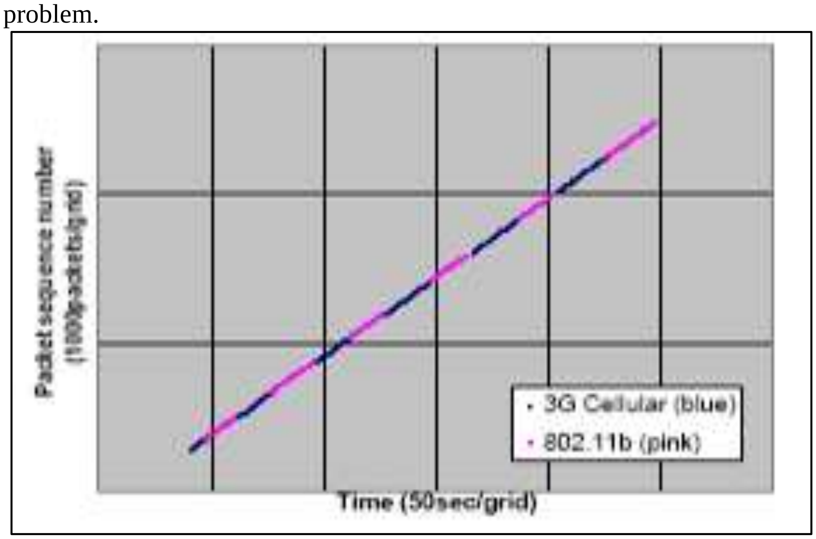

Fig. 4: Video with Mobile IP using MIMM

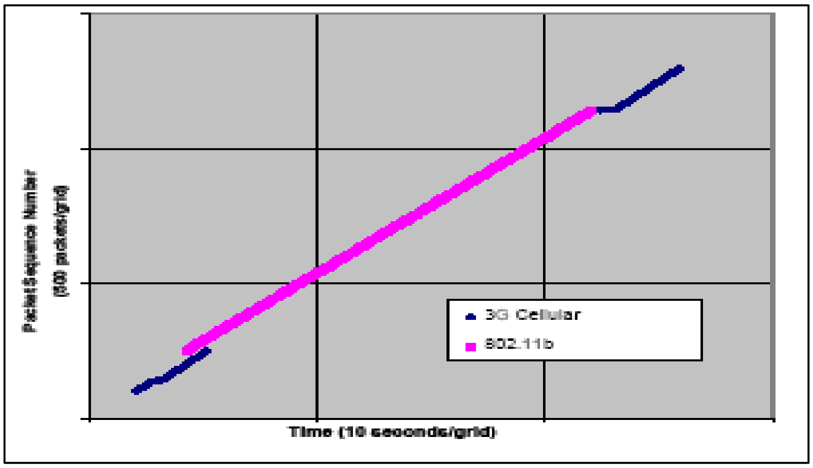

Fig. 5: Video with Mobile SIP Mobility using MIMM

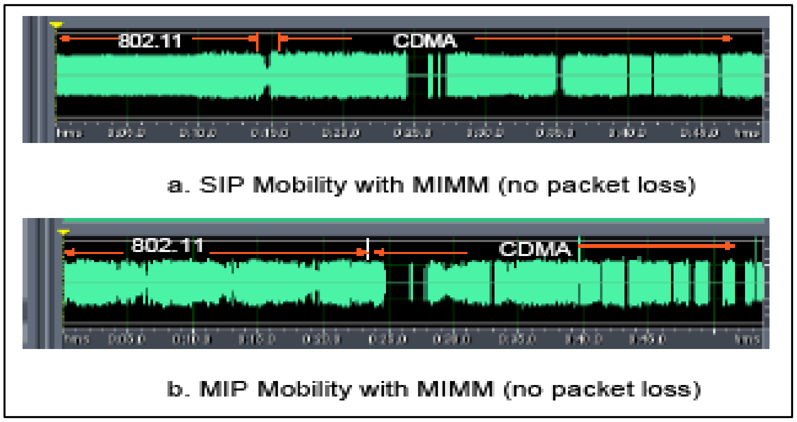

Fig. 6: Audio Sample with MIMM

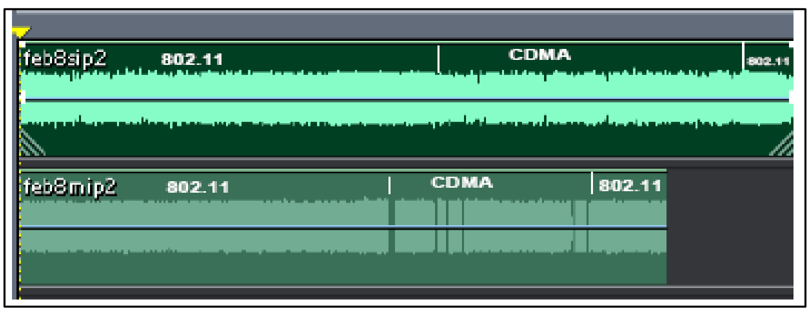

Fig. 7: MIMM-SIP/MIP (802.11-CDMA-802.11)

IV. CONCLUSIONS

The date which we have provided heterogeneous mobility involving wireless LAN and cellular network, we have shown how real-time communication is affected without any make-before- break mechanism because of excessive delay and packet loss during the handover. Some obvious and interesting results relating to WAN-WLAN handoff were shown. We used MIMM module within the mobile and demonstrated that the packet loss and delay is reduced drastically so that it can support the real-time communication. MIMM module within a mobile incorporates make-before-break mechanism and enhances both SIP and MIP-based mobility management. We also observed that SIP'S large signaling message size contributed to re-transmission in the narrow-band link. However SIP-based mobility seems to offer better flexibility when used in conjunction with MIMM, compared to Mobile IP and MIMM combination because of direct binding update between the CH and MN.

REFERENCES

[1] J. Rosenberg, H. Sculzrinne, et al , "SIP, RFC 3261
[2] Q. Zhang et al, "Efficient Mobility Management for Vertical Handoff between WWAN and WLAN, IEEE Communication Magazine, Nov 2003.
[3] H. Schulzrinne et al, Transport Protocol for Real-time application, RFC 3550.

[4] A Anusha Priya, R Gunasundari, Securing Data on the Cloud Server by the User Authentication and Data Security Techniques, 2017, International Journal of Computer Applications, Volume 165, Issue 4.

[5] A.Anusha Priya, Lavanya.C, Enhanced Focus on User Revocation in Secure Dynamic Auditing For Data Storage in Cloud, 2016/8, International Journal of Emerging Technology in Computer Science & Electronics, Volume 23, Issue 4, Pages 51-55.

[6] A.S.Syed Navaz & G.M. Kadhar Nawaz, "Ultra-Wideband on High Speed Wireless Personal Area Networks" August – 2014, International Journal of Science and Research, Vol No – 3, Issue No – 8, pp.1952-1955.

[7] A.S.Syed Navaz & Dr.G.M. Kadhar Nawaz & A.S.Syed Fiaz "Slot Assignment Using FSA and DSA Algorithm in Wireless Sensor Network" October – 2014, Australian Journal of Basic and Applied Sciences, Vol No –8, Issue No –16, pp.11-17.

[8] A.S.Syed Navaz, J.Antony Daniel Rex, S.Jensy Mary. "Cluster Based Secure Data Transmission in WSN" July – 2015, International Journal of Scientific & Engineering Research, Vol No - 6, Issue No - 7, pp. 1776 – 1781.

[9] A.S.Syed Navaz, P.Jayalakshmi, N.Asha. "Optimization of Real-Time Video Over 3G Wireless Networks" September – 2015, International Journal of Applied Engineering Research, Vol No - 10, Issue No - 18, pp. 39724 – 39730.

[10] A.S.Syed Fiaz, N.Asha, D.Sumathi & A.S.Syed Navaz "Data Visualization: Enhancing Big Data More Adaptable and Valuable" February – 2016, International Journal of Applied Engineering Research, Vol No - 11, Issue No - 4, pp.–2801-2804.

[11] A.S.Syed Navaz & Dr.G.M. Kadhar Nawaz "Flow Based Layer Selection Algorithm for Data Collection in Tree Structure Wireless Sensor Networks" March – 2016, International Journal of Applied Engineering Research, Vol No - 11, Issue No - 5, pp.–3359-3363.

[12] A.S.Syed Navaz & Dr.G.M. Kadhar Nawaz "Layer Orient Time Domain Density Estimation Technique Based Channel Assignment in Tree Structure Wireless Sensor Networks for Fast Data Collection" June - 2016, International Journal of Engineering and Technology, Vol No - 8, Issue No - 3, pp.–1506-1512.

[13] A.S.Syed Navaz, N.Asha & D.Sumathi "Energy Efficient Consumption for Quality Based Sleep Scheduling in Wireless Sensor Networks" March - 2017, ARPN Journal of Engineering and Applied Sciences, Vol No - 12, Issue No - 5, pp.–1494-1498.

[14] A.S.Syed Fiaz, M. Usha and J. Akilandeswari "A Brokerage Service Model for QoS support in Inter-Cloud Environment",March 2013, International Journal of Information and Computation Technology, Vol.3, No.3, pp 257-260,

[15] A.S.Syed Fiaz, R.Pushpapriya, S.Kirubashini & M.Sathya "Generation and allocation of subscriber numbers for telecommunication", March2013, InternationalJournal of Computer Science Engineering and Information Technology Research, Vol No: 3; Issue No: 1, pp. 257-266.

[16] M. Usha, J. Akilandeswari and A.S.Syed Fiaz "An efficient QoS framework for Cloud Brokerage Services", Dec. 2012, International Symposium on Cloud and Service Computing, pp: 76-79, 17-18, IEEE Xplore.

[17] G.Naveena, A.Anusha Priya, A Certain Investigation on Cluster Based Medium Access Control and QoS Aware Routing Protocol for Heterogeneous Networks, 2016, International Journal for Scientific Research & Development, Volume 4, Issue 7, Pages 1117-1122.

[18] S.Yasmin, A.Anusha Priya, Decentralized Entrance power with Secret Endorsement of data Stored in Clouds, 2015/8, International Journal of Innovative research in Computer and Communication Engineering, Volume 3, Issue 8, Pages 7279-7284.

[19] A.Anusha Priya G.Vijayalakshmi, Perceiving Kernel-Level Rootkits Using Data Structure Invariants, 2015/7, International Journal of Innovative Research in Computer and Communication Engineering, Volume 3, Issue 7, Pages 6719-6724.

[20] N.Thavamani, A.Anusha Priya, A QOD-Slanting Scattered Steering Procedure for Fusion Wireless Set of Connections, 2015/7, International Journal of Innovative Research in Computer and Communication Engineering, Volume 3, Issue 7, Pages 6752-6757.

[21] V.Yamuna, A.Anusha Priya, Efficient and Secure Data Storage in Cloud Computing RSA and DSE Function, 2015/7, International Journal of Innovative Research in Computer and Communication Engineering, Volume 3, Issue 7, Pages 6758-6763.

[22] M.Ravi A.M.Nirmala, P.Subramaniam, A.Anusha Priya, Enriched Performance on Wireless Sensor Network using Fuzzy based Clustering Technique, 2013, International Journal of Advanced Studies in Computer Science and Engineering, Volume 2, Issue 3, Pages 11-17.

[23] A Anusha Priya, A Mohanapriya, An Effective Scrutiny of Static and Dynamic Load Balancing In Cloud, August 2016, International Journal of Emerging Technology in Computer Science & Electronics, Volume 23 Issue 4, Pages – 27 -30.

[24] P.Vijayakumar, A.Anusha Priya, Stabilize the Movement of Nodes on anycast Routing with jamming responsive in mobile ad-hoc networks, September 2015, international Journal of Engineering Sciences & Research Technology, Volume 4 Issue 9,Pages – 207 -214.

[25] M.Balaji, E.Aarthi, K.Kalpana, B.Nivetha, D.Suganya "Adaptable and Reliable Industrial Security System using PIC Controller" 2017/5, Journal International Journal for Innovative Research in Science & Technology, Volume 3, Issue 12, Page 56-60.