

Heterogeneous Interface Mobile Node in NS2

Sachin Dattatraya Patil, Varshapriya Jyotinagar

Abstract- The heterogeneous interface for the mobile node is the key feature for the next generation mobile world. It provides the flexibility for the mobile devices for moving devices to the next available best network for high data rate connection. So it is firstly important to develop in ns2 for the research and educational purposes. It is very important to develop it in ns2 so that we can do experiment on the heterogeneous interface. The heterogeneous interface provides the mobility to the networks that is we can connect to any best available network like WIFI/WIMAX/UMTS for fast data connection. In this paper we will discuss about the various methods of implementation for heterogeneous interface of mobile node in ns2. Here we will show multiple WIFI interface, multiple WIMAX interface and finally heterogeneous interface between WIFI and WIMAX.

Keywords—multiple heterogeneous interfaces in NS2, WIFI and WIMAX heterogeneous interface, heterogeneous mobile node, multiple interfaces in ns2, mobile node for always best connected.

I. INTRODUCTION

In the Next-Generation (NG) mobile networks, hybrid network switching techniques are expected to enable the integration of heterogeneous networks, e.g. WIFI and WIMAX. In the hybrid network switching Mobile Node (MN) is switched between networks of different wireless technologies, or between networks of multiple operators. Figure 1 illustrates the procedures involved in a network switching in the integration of WIFI and WIMAX. Generally, network switching involves network selection from a list of discovered Point of Attachments (POA). The Mobile Node's (MN) association with newly selected interface can be established while keeping an ongoing session with the current interface. To support network switching, MN must have multiple heterogeneous network interfaces for accessing various networks.

Now a days accessing wireless services in the moving life is become important part of life. Due to this social new researches and business strategies has a fast development in the mobile world. We have lots of technologies in the wireless world like GSM, GPRS, 3G, WIFI, WIMAX, etc. according to requirement of bandwidth. Mostly WAN network used for wide range but having slow data rate connection in contradictory with WIFI and WIMAX they are having less range but having high bandwidth rate. But in today's life everyone wants the high bandwidth network. So it is the main requirement for the next generation network that it should

provide the high bandwidth connection whenever it is available. That's why wireless accessing devices should have the network switching features for switch to the best available network. Adding to the existing public networks, some private institutions have created the wireless infrastructure to support mobility within their areas, thus adding to the access of wireless networks. So that we will required the guarantee end-user terminal mobility and maintain always-on session connections to the Internet. To achieve this objective, we will require the automatic selection of network for end user devices. A "hot" item, frequently debated in the wireless community these days, is whether there is such a thing as a "fourth generation" (4G) of wireless systems that is likely to appear after the successful deployment of the current third-generation (3G) systems, say five to ten years from now.

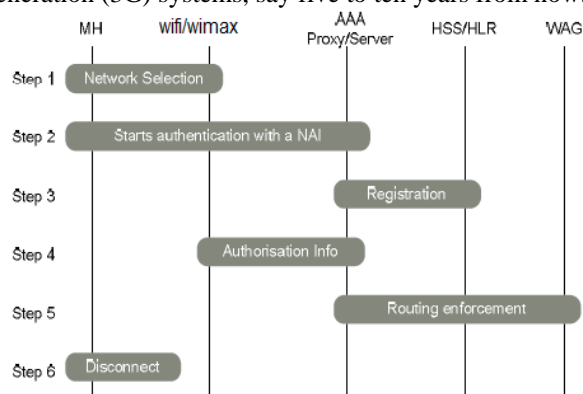


Fig.1 Switching Network from WIFI ⇌ WIMAX.

This new generation of wireless systems is supposed to complement and replace 3G systems, as well as second-generation (2G) systems that have already been in use for about a decade. A "classic" approach would design such a "system" in the same way as previous generations of wireless systems, that is, yet again focus on higher data rates (now beyond 2 Mb/s) and find new frequency bands for a worldwide standard [1]. For a number of reasons, however, it is not obvious that the roadmap is this straightforward. One of the main concerns is that 4G wireless infrastructures will be deployed in an environment where many other types of wireless, and wired, communications systems are already present. Furthermore, some people argue that future wireless communications will become focused on services and user needs, thereby forcing the mixture of available wireless infrastructure elements to be used in a more transparent way. In that case, the previously so important air interface standard

and frequency band issues will become secondary concerns. By definition it is difficult to make precise statements on the nature of this kind of vision. An important factor contributing to this uncertainty is that we have very limited knowledge about the future environment in which a 4G wireless infrastructure should function. Which of today's systems will still exist when a potential 4G infrastructure is deployed? Which systems and solutions will be considered successful then? What technical bottlenecks will be apparent 10 years from now? What market impact will 3G wireless systems have? How will this affect user behavior and user demand? How much money are prospective users willing to pay for services provided over this infrastructure? As these questions indicate, defining relevant research topics with regard to future systems is not an easy task. Nevertheless, experience tells us that fundamental research related to 4G systems has to be carried out today in order to make it possible to deploy them a decade from now.

This idea will support the following features [11]:

- Mobility management is spitted between local and global domains. As such, access network operators will -have the flexibility to choose the mobility management inside their networks. The main advantage is that the access provider is free to choose any option for local mobility, including layer 2, layer 3 or legacy mobile technologies.
- It supports handovers with QoS through a common framework for mobility and QoS signaling in heterogeneous technology networks. This common framework is based on the IEEE 802.21 draft standard.
- It supports host multihoming - the host owns multiple physical network interfaces and concurrently gets access through them.
- It explores an identity based mobility management solution through the independent and general management of identities - this would enhance from traditional network mobility protocols towards a solution for mobility of identities.
- It integrates MANETs (ad-hoc networks) and NEMOs (mobile networks) in the mobility architecture.
- It integrates broadcast networks, also considering unidirectional networks without return channel. It also supports QoS in multicast services running through broadcast networks.
- It integrates ubiquitous and pervasiveness concepts for customized services to the users.

II. LITERATURE SURVEY

As we have seen in our previous paper [11] that past work and our goal to implement it. We are proceeding with our new ideas and innovation with the difficulties in last paper ideas. So you can go through my previous paper for basic Mobile node architecture and detailed literature survey. As we have seen network usage and demand for speed, multimedia support and other resources have increased, so that wireless world had to look for a new generation technology to replace the existing wireless generation. That's why the 4G (fourth generation) has been introduced. The 4G communications

systems will be a composite communication model this is the main feature of 4G. In this model different kinds of technologies such as cellular, satellite and Wireless Local Area Networks and wired networks will interact with each other to provide an optimum service at anytime from anywhere to the mobile devices. Cellular networks as GPRS, UMTS and CDMA support a low bandwidth over a high coverage. On the other hand systems as WLAN like WIFI and WIMAX provide a high bandwidth (up to 54 Mbps) for a small range area. Therefore the integration of both this technologies WLAN and cellular systems can efficiently achieve a suitable capacity and Quality of Service for the mobile node.

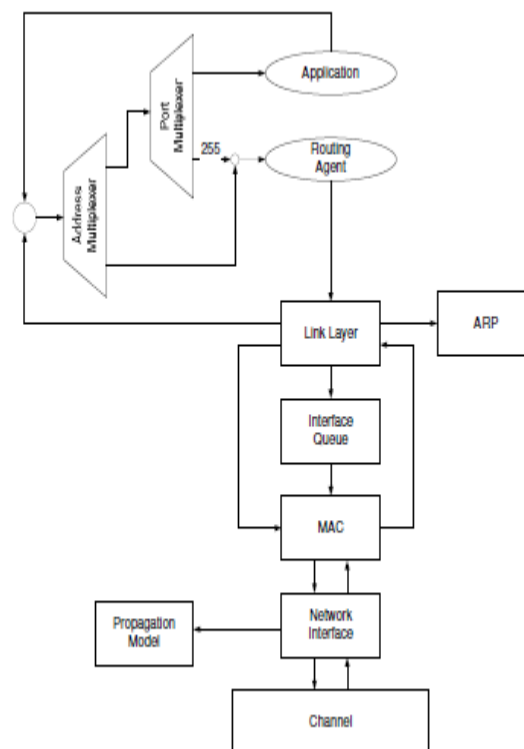


Figure 2: Mobilenode architecture under the wireless extensions to NS [10].

We are expecting from 4G wireless communication is to provide better speed, high capacity, lower cost and IP based services. One of the main desired features of next generation technology is High usability with global roaming. The end user devices should be compatible with any technology, at anytime, anywhere in the world. The basic idea is that the user should be able to move to any place, for example, from a place that uses CDMA to another place that employs GSM. Another feature of a 4G mobile system is "Always Best Connected" (ABC) which enable users to choose the best available access networks in a way that best suits their needs. Multiple interface mobile node only can use ABC service. The motivation for this project is gained by the fact that every mobile node in the future 4G network should

have multiple heterogeneous interface in order to satisfy the desired features of “Always best connected”.

Vangelis Gazis, Nikos Housos proposed 4G Network Architecture in [6]. The discussion about 4G mobile has given the feature vision of “Always Best Connected” (ABC) mode of communication. This shows the heterogeneous communication system should have different wireless access networks, where the user enjoys seamless connectivity and ubiquitous access to applications over the different combination of wireless systems available which is most efficient. They identified the major developments in the fourth generation mobile communication market, presented the technical aspects of the fourth generation network architecture and analyzed the implications of the “ABC”.

Chan-Wah Ng and Thierry Ernst explored with the benefits of having multiple access interfaces when these nodes employ layer-3 protocols such as Mobile IP or Network Mobility Basic Support to gain persistent access to the Internet while changing their points of attachment to the Internet [7].

A. The basic Mobile Node architecture in NS

The wireless model essentially consists of the MobileNode at the core, with additional supporting features that allows simulations of multi-hop ad-hoc networks, wireless LANs etc. MobileNode is the basic NSNode object with added functionalities like movement, ability to transmit and receive on a channel that allows it to be used to create mobile, wireless simulation environments. The class MobileNode is derived from the base class Node. MobileNode is a split object. The mobility features including node movement, periodic position updates, maintaining topology boundary etc are implemented in C++ while plumbing of network components within MobileNode itself (like classifiers, dmux, LL, Mac, Channel etc.) have been implemented in Otcl. The network stack for a mobilenode consists of a link layer(LL), an ARP module connected to LL, an interface priority queue(IFq), a mac layer(MAC), a network interface(netIF), all connected to the channel. These network components are created and plumbed together in OTcl. The five ad-hoc routing protocols that are currently supported are Destination Sequence Distance Vector (DSDV), Dynamic Source Routing (DSR), Temporally ordered Routing Algorithm (TORA), Ad hoc On-demand Distance Vector (AODV) and Protocol for Unified Multicasting Through Announcements (PUMA) [11].

B. Requirements and Working Assumptions

Here mentioned the requirement for multiple heterogeneous interfaces. The details about these requirements can be found in the reference paper [11]

- [REQ.1] The number of channels in a particular scenario should be modifiable.
- [REQ.2] The number of interfaces per node is variable, and do not need to be the same for all nodes within a single scenario.

- [REQ.3] Each node within the same scenario could connect to a different number of channels (of the ones that had been previously defined).

- [REQ.4] Routing agents may take advantage of the modified model, but legacy operation of the simulator must be preserved, so as to ensure backwards compatibility.

III. IMPLEMENTATION

As we have discussed the Multiple Interface Model in our last paper [11] so we will directly discuss here implementation issues. For adding interface we had previously mentioned our strategy. According that strategy we have created the homogenous WIFI interface and homogenous WIMAX interface in NS 2.30. After creating this we are forwarding to the heterogeneous interface. Before discussing about we are showing here some snapshot of our implementation.

```

Applications Places System
suhaas@sachin-laptop: ~/NS2/NDSL/ns-allinone-2.30/examples
File Edit View Terminal Help
suhaas@sachin-laptop:~$ cd NS2/NDSL/ns-allinone-2.30/examples/
suhaas@sachin-laptop:~/NS2/NDSL/ns-allinone-2.30/examples$ ns wfi2.tcl
num nodes is set 6
INITIALIZE THE LIST xListHead
INITIALIZE THE LIST xListHead
Starting Simulation...
channel.cc:sendUp - Calc highestAntennaZ_ and distCST_
highestAntennaZ_ = 1.5, distCST_ = 550.0
SORTING LISTS ..DONE!
SORTING LISTS ..DONE!
NS EXITING...
suhaas@sachin-laptop:~/NS2/NDSL/ns-allinone-2.30/examples$

```

Fig. 3 Output For WIFI.

```

Applications Places System
suhaas@sachin-laptop: ~
File Edit View Terminal Help
suhaas@sachin-laptop:~$ ns wimax-multi2.tcl
num nodes is set 2
INITIALIZE THE LIST xListHead
INITIALIZE THE LIST xListHead
channel.cc:sendUp - Calc highestAntennaZ_ and distCST_
highestAntennaZ_ = 1.5, distCST_ = 550.0
SORTING LISTS ..DONE!
SS 2 is sending RNGREQ to BS
BS is sending RNRGSP to SS 1
SS 1 is sending RNGREQ to BS
SORTING LISTS ..DONE!
SS 3 is sending RNGREQ to BS
suhaas@sachin-laptop:~$

```

Fig. 4 Output For WIMAX.

```

s 2.0000000000 1 AGT --- 0 tcp 40 [0 0 0 0] ----- [1:0 2:0 32
0] [0 0] 0 2127616
s 2.0001150000 1 MAC --- 0 AODV 100 [0 ffffffff 2 800] -----
[1:255 -1:255 30 0] [0x2 1 1 [2 0] [1 4]] (REQUEST)
r 2.0000915547 0 MAC --- 0 AODV 48 [0 ffffffff 2 800] -----
[1:255 -1:255 30 0] [0x2 1 1 [2 0] [1 4]] (REQUEST)
s 2.0001896774 0 MAC --- 0 AODV 100 [0 ffffffff 0 800] -----
[0:255 -1:255 29 0] [0x2 2 1 [2 0] [1 4]] (REQUEST)
r 2.0002697321 1 MAC --- 0 AODV 48 [0 ffffffff 0 800] -----
[0:255 -1:255 29 0] [0x2 2 1 [2 0] [1 4]] (REQUEST)
s 2.0005627281 0 MAC --- 0 AODV 100 [0 ffffffff 1 800] -----
[0:255 -1:255 29 0] [0x2 2 1 [2 0] [1 4]] (REQUEST)
r 2.0006427931 2 MAC --- 0 AODV 48 [0 ffffffff 1 800] -----
[0:255 -1:255 29 0] [0x2 2 1 [2 0] [1 4]] (REQUEST)
s 2.0006867931 2 MAC --- 0 ARP 80 [0 ffffffff 3 806] -----
[REQUEST 3/2 0/0]
r 2.0007508581 0 MAC --- 0 ARP 28 [0 ffffffff 3 806] -----
[REQUEST 3/2 0/0]
s 2.0007803581 0 MAC --- 0 RTS 44 [4fe 3 1 0]
r 2.0008156232 2 MAC --- 0 RTS 44 [4fe 3 1 0]
s 2.0008166232 2 MAC --- 0 CTS 38 [3c4 1 0 0]
r 2.0008470882 0 MAC --- 0 CTS 38 [3c4 1 0 0]
s 2.0008480882 0 MAC --- 0 ARP 80 [13a 3 1 806] ----- [REPLY
1/0 3/2]
r 2.0009121532 2 MAC --- 0 ARP 28 [13a 3 1 806] ----- [REPLY
1/0 3/2]
s 2.0009131532 2 MAC --- 0 ACK 38 [0 1 0 0]
r 2.0009436182 0 MAC --- 0 ACK 38 [0 1 0 0]
s 2.0009505532 2 MAC --- 0 RTS 44 [57e 1 3 0]
r 2.0009858182 0 MAC --- 0 RTS 44 [57e 1 3 0]
    
```

Fig. 5 Snapshot for the TraceFile of homogeneous WIFI.

```

s 0.0000000000 0 MAC --- 0 DCD 24 [0 0 ffff0000 0] ----- [0:0
0:0 0]
s 0.0000000000 0 MAC --- 0 UCD 24 [0 0 ffff0000 0] ----- [0:0
0:0 0]
r 0.0000000547 1 MAC --- 0 DCD 24 [0 0 ffff0000 0] ----- [0:0
0:0 0]
r 0.0000000547 1 MAC --- 0 UCD 24 [0 0 ffff0000 0] ----- [0:0
0:0 0]
s 0.0000000547 1 MAC --- 0 RNGREQ 10 [0 2000000 0 0] -----
[0:0 0:0 0 0]
r 0.000001094 0 MAC --- 0 RNGREQ 10 [0 2000000 0 0] -----
[0:0 0:0 0 0]
s 0.000001094 0 MAC --- 0 RNGRSP 24 [0 0 0 0] ----- [0:0 0:0
0:0 0]
r 0.000001642 1 MAC --- 0 RNGRSP 24 [0 0 0 0] ----- [0:0 0:0
0:0 0]
s 0.000108400 0 MAC --- 0 DLMAP 10 [0 0 ffff0000 0] -----
[0:0 0:0 0 0]
r 0.000108947 1 MAC --- 0 DLMAP 10 [0 0 ffff0000 0] -----
[0:0 0:0 0 0]
s 0.000325200 0 MAC --- 0 ULMAP 10 [0 0 ffff0000 0] -----
[0:0 0:0 0 0]
r 0.000325747 1 MAC --- 0 ULMAP 10 [0 0 ffff0000 0] -----
[0:0 0:0 0 0]
s 0.0005108400 0 MAC --- 0 DLMAP 10 [0 0 ffff0000 0] -----
[0:0 0:0 0 0]
r 0.0005108947 1 MAC --- 0 DLMAP 10 [0 0 ffff0000 0] -----
[0:0 0:0 0 0]
s 0.0005325200 0 MAC --- 0 ULMAP 10 [0 0 ffff0000 0] -----
[0:0 0:0 0 0]
    
```

Fig. 6 Snapshot for the TraceFile of homogeneous WIMAX.

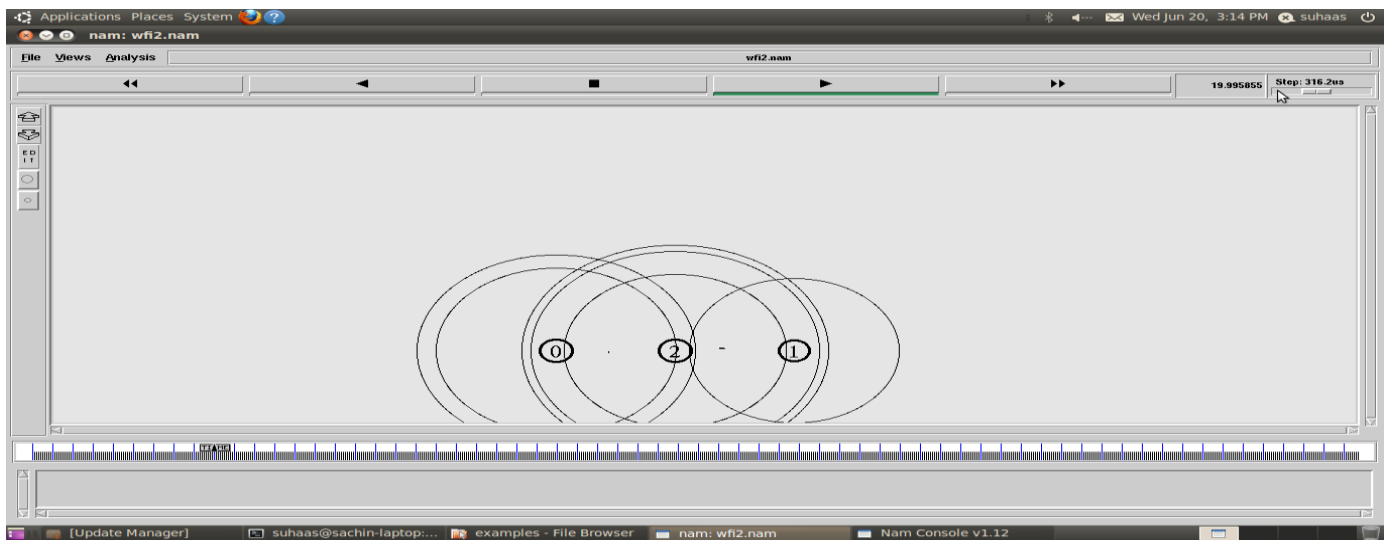


Fig. 7 Snapshot for the network animator for WIFI.

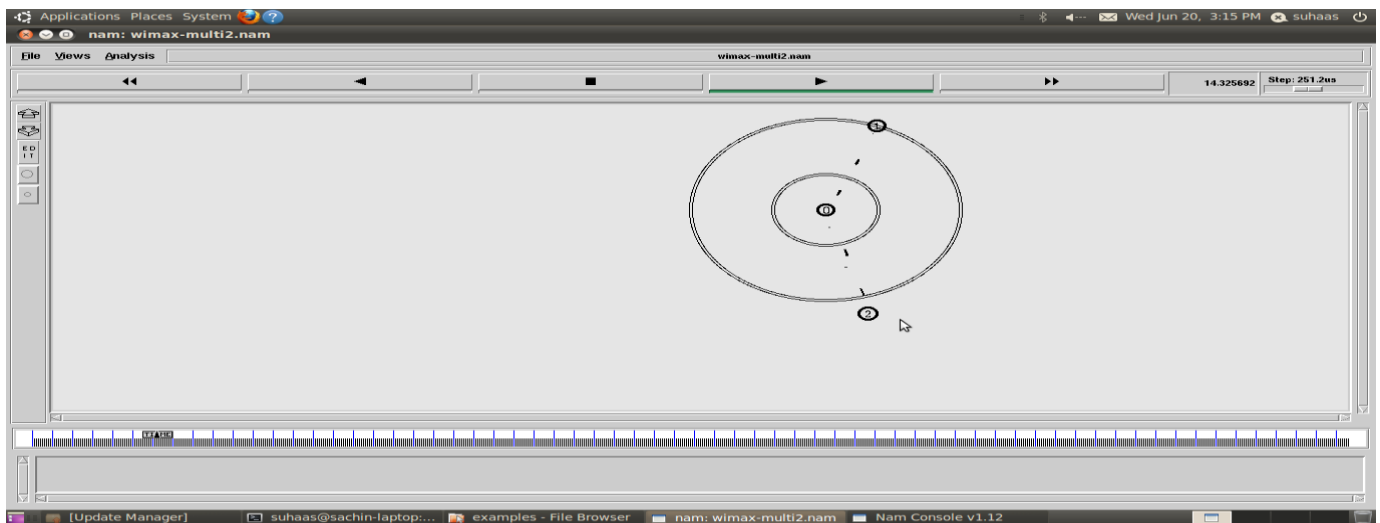


Fig. 8 Snapshot for the network animator for WIFI.

Here in fig. 5 and fig. 6 shows the trace file of the WIFI and WIMAX interface. In that trace file shows the output of how the interface will change from time time. And it transmits the data to the receiver according to the availability of the interface. In the fig. 7 and fig. 8 shows network animator for the same above trace file. Here it shows the packet transmission and acknowledgement receiving for both WIFI and WIMAX. In the next figures 3 and 4 shows terminal output for both. Here it shows we can set the any number of interfaces for the node. Also we can set number of nodes.

As we have told in our last paper that for heterogeneous interface we have to use the for loop for choosing the MAC ID in the routing table. But in the reality it is still not possible to us to include the two MAC ID in the same tcl file for the same mobile node. Because if we can not give two MAC ID in the same tcl file while creating tcl animator file it only take one MAC ID at the same time from the 802.11/802.16. Hence we are having difficulty to insert the heterogeneous interface in the ns2.

For that purpose we are choosing the alternate solution for this. In the alternate solution we are thinking about the strategy “Node As Interface”. In this “Node As Interface” we will take one node as one interface. And will insert the WIFI interface to one node and WIMAX interface to other node then finally it will combine to one blank node so that will have both the interface. It will create the heterogeneous interface for this mobile node and will satisfy our purpose of multiple heterogeneous interface.

IV. FUTURE WORKS

Extended to the previous paper we will extend our feature work for creating the heterogeneous interface in the single node system. As in our alternate solution we implement as many interfaces in ns2 and can insert many nodes to the single blank mobile node to create the heterogeneous interface. But

in our previous mode of thinking we are still not succeeded. So we have to work on it first to implement the heterogeneous interface on the single node.

REFERENCES

- [1] J. Z. Sun, J. Sauvola, D. Howie, “Features in future: 4G visions from a technical perspective”, Global Telecommunications Conference, 2001. GLOBECOM'01, IEEE, Volume:6, 25-29, pp:3533 - 3537 vol.6, Nov.2001.
- [2] Mo Li, Kumbesan Sandrasegaran and Tracy Tung, "A Multi-Interface Proposal for IEEE 802.21 Media Independent Handover", Sixth International Conference on the Management of Mobile Business, IEEE, Jul 2007
- [3] Bria A, Gessler F, Stridh R, Unbehaun M, "4th-Generation Wireless Infrastructures-Scenarios and Research Challenges ", Personal Communications, IEEE, Dec 2001.
- [4] Andrey Krendzel, "Network Planning Aspects of 3G/4G Mobile Systems", Thesis for Doctor of Technology, Sep.2005.
- [5] Hyun-Jong Kim, Won-Seok Choi "A Method to Support Multiple Interfaces a Mobile Node in Network-based Mobility Management", Optical Internet (COIN), 9th International Conference on mobility management, Jul 2010
- [6] Vangelis Gazis, Nikos Housos, Athanasia Alonistioti and Lazaros Merakos, "Generic System Architecture for 4G Mobile Communication", Vehicular Technology Conference, VTC 2003-Spring. The 57th IEEE Semiannual, Apr 2003.
- [7] Chan-Wah Ng and Thierry Ernst, "Multiple Access Interfaces for Mobile Nodes and Networks", Proceedings.

- 12th IEEE International Conference on Networks, Nov 2004.
- [8] Josh Broch, David A. Maltz, David B. Johnson, "Supporting Hierarchy and Heterogeneous Interfaces in MultiHop Wireless Ad Hoc Networks", Proceedings of the Workshop on Mobile Computing, ISPAN, June 1999.
- [9] Adding Multiple Interface Support in NS-2 Ram´on Agüero Calvo University of Cantabria ramon@tmat.unican.es Jes´us P´erez Campo University of Cantabria jesus@tmat.unican.es January, 2007
- [10] The VINT Project. The NS Manual, May 2010.
- [11] "Implementation of Multiple Heterogeneous Interfaces Mobile Node in NS2", Sachin Dattatraya Patil, sdp.sachin@gmail.com, Varshapriya Jyotinagar, varshapriyajn@vjti.org.in, VJTI, Mumbai, International Journal of Engineering Innovation & Research Volume 1, Issue 2, ISSN : 2277 – 5668.

First Author Sachin Dattatraya Patil, born in Kolhapur district at 10th June 1987. Pursuing M.Tech (Computer science (Network Infrastructure and Management System)) from VJTI, Mumbai, Maharashtra-400019. Pursued the degree bachelor of engineering from Government College of engineering Karad in the specialization of Information Technology.

I have the experience of lectureship in engineering college in the subject of Information Technology. I have the membership of Computer society of India (CSI).

Second Author Varshapriya Jyotinagar, Associate Professor at *Computer technology in VJTI, Mumbai*.