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IPv4/IPv6 Transition Expenses Paradigm using a Node Multi Homing Approach (Multihmcost6)

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Abstract

This research paper pinpoint on one of the 20th century very popular communications protocols that located at the heart of an Internet the Internet Protocol(IP), which allows data and other traffic to roam the Internet and to arrive at the desired destination. In this innovative research work we estimated and investigated an economical and technological IPv4/IPv6 a novel node multi homing transition expenses model named Multihmcost6**.** The process of deploying IPv6 looks like a complex and expensive operation, however careful planning and choosing the right technique actually converts the transition to IPv6 smooth and easy. Moving from IPv4 to IPv6 is not so easy, straight forward, and ideas to simplify the migration between the two versions have to be standardized. The Multihmcost6 prototype of IPv4/IPv6 node multi homing approach can speed up the IPv4/IPv6 migration faster and however the overall migration cost is either relatively low, medium or high depending on our assumptions and basic requirements**.** This research paper provides an analysis of the potential benefits of IPv6, as compared to IPv4. It also outlines the principal direct and indirect expenses that entities will likely incur to deploy IPv6 in a node multi homing approach.

The Multihmcost6 supports an economical and technological expenses prediction and estimation graph with the following important points such as

1)An Actual rate of Hardware which specifies an economical value.
2)Real expenses of Software and an Operating Systems costs.
3)Labour outlay.
4)An Un anticipated charge and
5)An another cost.

This paper discusses and highlights the role and status of Multihmcost6 and also how multihmcost6 approach can increase the IPv4/IPv6 node multi homing transition type faster and also to determine whether the migration mechanism takes place in a very soft and smooth manner. This research article also considers concepts and ideas related to the interoperability of an IPv4 protocol and an IPv6 protocol devices and networks across national borders.

General Terms: IPv4, IPv6, Multihmcost6 etc.

Additional Key Words and Phrases: Multi homing, Node multi homing approach, H/W cost, S/W cost, Labor costs(Training amounts), Other costs.

1. Introduction

1.1. Compare and Contrast IPv4 with IPv6.

IPv6(i. e. next generation IP) is one of the advanced version of an Internet protocol(IP) that supports very large number of benefits over the existing IPv4. One of the major significant problem with the IPv4 is its limited addressing capacity. The IPv4 is one which can address 2^{32} nodes on the Internet due to its 32 bits addressing hierarchy. The IPv6 recent internet version protocol increases the address length from 32 bits to 128 bits to enhance addressing capability. A novel category of address such as any cast is introduced and which is used to send a packet to any one of a group of nodes. As we know that the IPv4 protocol header size varies between 20 bytes and 60 bytes. It consists of minimum 20 bytes and maximum 60 bytes option and padding fields. On the other hand IPv6 consists of minimum 40 bytes for IPv6 header. While IPv4 header size comprises of 13 different fields IPv6 header length which comprises of 8 fields. Already Packet fragmentation and reassembly fields have been left from IPv6 packet header. The two important fields such as packet fragmentation and reassembly fields are done only by source and destination hops respectively. Therefore, in IPv6 protocol, packet processing speeds increase in intermediate routers and header format simplification helps decreasing the bandwidth cost. On the other hand, IPv4 datagrams must be fragmented according to the expectations of link and hop maximum packet size by border routers.

Flow labeling capability is also an another important property supported by IPv6. It marks the packets which request special handling by the intermediate routers. A flow is identified by the combination of two important senders address, and destination address and flow label. Thus, all packets must be integrated jurisdiction of the same flow are allocated the same flow label by the source. Hop limit shows the remaining number of allowable nodes for a packet in its routing. It is decremented by 1 at each hop that forwards the packet. The Time to Live field in IPv6 header perform the same work but it works via time. The extension headers are mainly utilized to improve the packet processing capability in the IPv6 header. Hop by hop options header, routing header, fragment header, authentication header, encapsulating security payload header and destination option

header are extension headers utilized in an IPv6 protocol. Each header includes a next header field except the encapsulating security payload header. Next header finds the type immediately following the header. It may be the identifier of another extension header or an upper layer protocol header such as TCP or UDP.

Novel properties of IPv6 enhances packet processing speeds over routers, switches and end systems. The traffic features and packet traffic characteristics are also affected with increasing amount of IPv6 protocol traffic. Therefore, our research work stresses on a detailed investigation of an IPv4/IPv6 Transition expenses paradigm using a Node Multi homing approach(Multihmcost6).

1.2 Concept of Multi homing.

Multi homing is a mechanism of connecting two or more similar or dissimilar distinct networks. Usually multi homing permits a terminal/host/workstation/node to affix two or more Internet Service Providers (ISP'S). The formal definition of multi homing is that a workstation/host/terminal/node or a LAN/WAN/MAN network is capable to couple to the Internet through one or more external links or ISP's rather than a single node. From the above formal definition we have proved that when a node is capable to connect to the Internet with multiple IP addresses as alternatives(even though when IP addresses belong to the same ISP)the site/terminal/workstation/node is known as "multi homed host".

The Internet Engineering Task Force(IETF) IPv6 Multi homing(multihmv6) also given multi homing a formal definition as "a site/terminal/workstation/node that has more than one connection to the public Internet with those connections through either the same or different ISPs. The multi homing technique is mainly adopted to achieve Network Fault tolerance(Service resilience)(Redundancy), Load balancing, Provider independent service, Performance, Policy based routing concern etc. The multi homing technique day by day becoming much more popular with the vast benefits of the eased renumbering network mechanism and the larger address space initiated by IPv6.

The Multihmcost6 is one which approaches Service resilience(Fault tolerance), Load sharing and provider independent services to Node multi homing approach, Site multi homing approach, Multi homing of Small ISPs and Multi homing of Transit ISP's at terminal/host/workstation/node phase. In this world so many companies are totally dependent on, Internet connectiction. So Internet takes place a vital importance. As a consequence, multi homing has become a highly reputed mechanism. The term multi-connecting or multi-attaching is also sometimes called multi homing when two or more interfaces of a network connected several times to a single network. The Multi homing methodologies are broadly categorized into four types such as Node Multi homing, Site Multi homing, Multi homing of Small ISPs, and Multi homing of Transit ISP's.

1)Node Multi homing: Node Multi homing is a mechanism of connecting a single host to multiple provides like a node that uses multiple interfaces with dissimilar IP addresses in order to add to dissimilar network service providers.

For ex: A Laptop or Desktop or Terminal or Node or Host which is connected to local area network through a wireless access and connected to the Internet via an Ethernet link.

2)Site Multi homing: It is one in which specifies a stub network which is mainly used to connect at least two or more dissimilar service providers. Site Multi homing potentially focuses a wide range of sites, from house internet users with two or three terminals to a very big enterprise networks consists of thousands of hosts.

3)Multihoming of Small ISPs: Multihoming of Small ISPs focuses to ISPs that have a local presence, that supports transit services to stub networks, and which is used to connect to two or more multiple different upstream providers. The small ISPs may be big enough to get their own provider-independent address spaces. Multi homing of small ISP's have maintained their own AS numbers, and they use BGP to advertise reach ability informations to other domains.

4)Multihoming of Transit ISPs is concerned to medium and large ISPs, that supports transit services to other ISPs or stub networks, and which connects to multiple dissimilar upstream providers. Terminal/host/workstation/node can be multi homed by using two different mechanisms like

1)Single network interface that is bound to multiple IP addresses, even when the IP addresses belong to the same ISP.

2)Homogenous multiple network interfaces such as multiple 802. 11b WLAN interfaces or heterogeneous like a Wireless LAN interface, a Bluetooth network interface, and a UMTS 3G network interface, which are bound to multiple addresses.

Multi homing also manages technical and non-technical integrity constraints such as Scalability, Simplicity, Multihoming Independence, Impact on Legacy System, Compatibility with Packet Filtering. The Multi homing mechanism also performs two responsibilities such as Fault-Tolerance, Traffic Engineering Strengths.

An Idea of Multihmcost6 is a mechanism that comes in transition of IPv4/IPv6 for multi homing nodes. Developing an expenses and expenditure rate estimation model for IPv4/IPv6 multi homing transition(multihmcost6) is a challenging and a very risky factor because of it is not only dependent on only one expenses factor, however multi homing transition charge appreciation model is totally dependent on various factors like Software rate, Hardware price, Training expenses and also on other rate factors. We can identify a couple of works carried out in approbating an economical and technical expenditures for the transition of IPv4/IPv6.

Rahmat Budiarto, A. Hadi Arifin, Dahl`an Abdullah, Sami Mohamed Berhan has discussed and highlighted the cost of transition from IPv4 to IPv6 in Universiti Sains Malaysia(USM), Malaysia. This cost consists of two aspects, first aspect is the economical cost which is true cost of hardware, software, training and other cost in which the sudden cost that takes place in the university system.

Guy almes described the cost of IPv6 deploying (Hardware expenses of Transition of IPv4/IPv6, Software rates of IPv4/IPv6, training amounts for the transition of IPv4/IPv6. He has estimated and computed different categories of transition prices and considerations. He has also worked on coexistence of

dual protocols. The Methodology of Node Multi homing Technique is shown in Fig. 1.

Nathan robinson, Cesar ramos, P. E. , Jose luis jara presented economic impact of IPv6. They have worked on clear impacts to transition, like personnel time and expenses from training, transition planning and trouble shooting, as well as material and equipment costs. All of these items may be tabulated rather easily, while the revenue cost savings and cost-benefit implications for IPv6 transition are less easily defined. One of the reasons for the lack of clarity of revenue is that it depends upon the development of applications that depend on and exploit the advances of IPv6 provides. Thus IPv6 benefits and cost savings depend largely upon the network environment and the strategic plan of the entity.

Michael P. gallaher, Brent R. rowe discussed costs of the transition to IPv6 for the major stakeholders like hardware vendors, software vendors, Internet user's, ISP's and the potential benefits. They have also calculated the cost impact of an accelerated adoption case and discussed the potential ways in which the government could become involved in the process.

Litan and Rivlin assert that a major feature of the Internet revolution:

is its potential to make the whole economic system, nationally and internationally, more competitive by rendering many markets closer to economists' textbook model of perfect competition, characterized by large numbers of buyers and sellers bidding in a market with perfect information.

Technical and Economic assessment of Internet protocol version 6(IPv6) discussion draft also explains adoption of IPv6 can potentially produce measurable benefits for users, equipment vendors and service providers. The IPv6 RFC comments and discussion with industry stake holders also estimated the costs and benefits of IPv4/IPv6 transition scenarios.

In this paper an IPv6 multi homing transition system called 'Multihmcost6' is designed and Implemented. Multihmcost6 supports Node multi homing approach, Site multi homing approach, Multi homing of Small ISPs and Multi homing of Transit ISP's. Multihmcost6 adopts a hybrid approach which adds both host based and router based solutions to achieve multi homing transition mechanism.

The various responsibilities that the multihmcost6 provides are as follows.

1)Multi homed network:Multihmcost6 provides an IPv6 multi homed network environment to hosts. Thus hosts can establish their connections with multiple link choices.

2)Link status monitoring:Multihmcost6 identifies and manages the network status of each link.

3)Fault Tolerance(Redundancy):The connectivity is maintained even in the event of a failure to the primary connection. Multihmcost6 will let the failed link be known to all hosts to prevent the loss caused by hosts trying to establish connections through the failed link. The fault tolerance can be broadly divided into two sub-clauses such as

1)Without Transparency: The ongoing transport sessions are splitted when there is a failure of one connection, and a new connection would be established to support the data transportation.

2)With Transparency: The ongoing transport sessions are not divided even when there is a failure of one connection, and a new connection would be established to support the data transportation.

4)Load balancing: By calculating loads, measuring bandwidths of all links, and measuring Round-Trip Time to ISPs' gateways, Multihmcost6 and hosts apply a message based mechanism to achieve load balancing.

The rest of this paper is organized as follows. In Section 1 Introduction to Multi homing approaches, Types of Multi homing types such as Node Multi homing, Site Multi homing, Multi homing of Small ISPs, and Multi homing of Transit ISP's and the various responsibilities of multihmcost6 are described. In Section 2 the concept of Innovative related research methodology of multihmcost6 is depicted.

2. Proposed Methodology

2. 1. Techniques to Predict IPv6 expenses in Multi homing approach(Multihmcost6)

In order to find out and design a basic migration expenses graph model for multi homing approach, we need to adopt some specific mechanisms that helps us in collecting the raw data and to design a good model like multihmcost6. In IPv4/IPv6 multi homing transition mainly there are two types of techniques that we can refer to design a multihmcost6 are listed as follows.

1. Statistical Technique(Mechanism)
2. Economic Assessment Technique.

1. Statistical Technique.

It is also a well known technique but due to the shortage of information regarding IPv4/IPv6 transition expenses model and the range of this type work more efficiently on a wider range such as ISP migration expenses where by we need to gather statistical data about an internet users and the ISP's itself .

2. Economical Assessment expenses Mechanism.

The second mechanism such as an economic assessment is also a very familiar type of expenses estimation paradigm, which we will refer in this research article. It is concerned about the direct expenditure that incurred from IPv4/IPv6 transition and deployment. It works in an appropriate manner with either all IT or Non-IT sectors.

For ex: This approach has referred by U. S. Department of commerce's National Telecommunications and Information administration for IPv6 cost in USA.

2. 1. Hardware expenses: This is the very first type of expense in a node multi homing transition approach. In order to design hierarchy of IPv6 Multi homing transition cost estimation model by using economic assessment approach, hardware costs, software and operating system costs, training costs, unpredictable costs etc are really playing an important role.

Hardware costs mainly consists of IPv6 router, which forwards IPv6 packets and its main purpose is to enable computer nodes to operate stable IPv6 networks. Depending on individual networks and the level of IPv6 use some hardware units can become IPv6 capable via software upgrades. However in order to realize the full benefits of IPv6 most hardware network. Specifically high-end routers, switches, memory and firewalls all will need to be upgraded to enable large scale IPv6 use within a network. Firewall hardware is also one of the important security issue and it serves like a packet filter. The other hardware costs in IPv4/IPv6 multi homing transition cost estimation model are network interface card, nodes, name server switches. The cost of this hardware is directly proportional to individual networks (i. e hardware α network) depending upon whether the network is small or huge. The hardware cost is also dependent on the level of IPv6 usage(i. e hardware **α** level of IPv6).

IPv6 transition mechanisms are broadly categorized into 3 types like Dual Stack, Tunneling issues, Header translation etc. The various types of hardware costs, software costs, and labour costs and other costs in different phases of transition are explained very briefly. The hardware costs in various mechanisms of dual stack, tunneling and header translation are explained below.

1. Substantial IPv6 using a dual-stack network:The mechanism of ameliorating or refurbishing remaining routers and all other networking devices are very high. Moreover hardware amount in dual stack network is high. So in order to measure the multi homing transition costs for dual stack network can be figure out as:

Hardware costs of dual stack network=N*H.

Where N=N number of hosts/nodes connected to either any LAN/WAN/MAN.

H=High cost of dual stack.

2. Minimal IPv6 using tunneling in a network:The process of rehabilitating/enhancing 1+ backbone routers or replacing firewall is medium(M). So this type of cost is said to be hardware costs. Therefore we have decided and confirmed the hardware cost in tunneling transition phase is medium. So in order to calculate

Multi homing transition costs for tunneling network is

Hardware costs of IPv4/IPv6 multi homing tunneling transition =N*H

Where N=N number of hosts/nodes connected to LAN/WAN/MAN.

H=High cost of tunneling network.

3. Native IPv6 with IPv4 translation.

According to our research expectations and predictions of hardware vendors the total hardware cost is very low and it is calculated as follows. The IPv6 stake holders are broadly categorized into three types Hardware vendors, Software vendors, Internet users and Internet Service Providers(ISP's) etc.

Total Multihmcost6 expenses=10%(hardware) +10%(software) +80%(labour expenses) +0%(other expenses). The Table-2 shows the Multi homing expenses estimation model to measure all expenses in multi homing approach according to the stake holders group.

2. 2. The software expenditures:The second type of multi homing transition cost factor in IPv4/IPv6 transition cost estimation model is software costs. Upgrading some software will be required to work with IPv6 and other software we should upgrade from time to time. The up gradation of software consists of server software which is necessary to operate the server computer and the desktop operating systems like software which is available by many vendors such as Microsoft and sun Micro systems .

The transition phases in IPv4/IPv6 are broadly categorized into dual stack, tunneling and header translation etc. The software costs in multi homing transition phase like IPv4/IPv6 dual stack phase is to be considered as substituting or an upgrading all applications to be IPv6 capable. The software costs in second phase of IPv4/IPv6 tunneling phase can be defined as the process of upgrading/replacing any applications utilized specifically for IPv6. The software cost in the third phase of IPv4/IPv6 transition like header translation can be defined as the process of installing new software depending on the requirements of translation required.

2. 3. Labor Costs(Training amounts):The third one more important cost estimation factor to analyze and calculate multi homing IPv4/IPv6 transition issue is labor costs. Labor cost is mainly dependent on training cost. The training cost may be either low or high depending on the training subject suppose if the training subject is very advanced or if it suits for the professional level. Based on our research results training cost is one of the most significant upgradable costs. The labor cost is mainly based on the level of understanding the network administration staff.

Therefore we can also conclude

i. e [Labor cost α Level of understanding (grasping power) network admin]. Training cost factor for large size organizations will be minimal with existing IPv6 expertise.

1. Tunneling:The labour costs in IPv4/IPv6 multi homing transition can be defined as the process of providing trainee for current Information technology employees. The labour costs can also be calculated on the basis of recruiting various types.

2. Dual stacks:The labour costs in tunneling phase is determined on the following factors.

1)Advanced IT training and network administration effort will be necessary before and after the installation.

2)Training should be provided to users to use new applications.

3. Header Translation:

1)Extra time or constant dedicated effort will be required to install and maintain translation devices.

2)Users running only IPv6 applications need additional training and extra support.

3)Extra dedicated effort will be necessary to install and maintain translation equipments.

4. Native IPv6 Only:

1)Time or effort to remove translation equipments and software.

2. 4:Other Prices:The cost estimation factor can also be analyzed and calculated by using one more cost estimation factor like other costs. The other costs are also broadly categorized into four types as follows. The other costs for IPv4/IPv6 multi homing transition phases like dual stack and tunneling occurs in the following manners.

1. Security threat effects in Tunneling as well as in Dual stack phase[16].

IPv6 address block(s), Lost employee productivity, Security intrusions, Foreign activities, Interoperability Issues.

Unexpected threat like security intrusion is considered to be one of an example for other costs[17].

Over 40 research suggestions and solutions for IPv6 multi homing have been proposed in the last few years. In this research manuscript we will describe the most relevant one(Multihmcost6) and compare them with the approach proposed by various research scholars, academicians, scientists in different research articles and journals. The basic comparison and contrast between these two approaches(i. e Economical and Technical costs for the Transition of IPv4–to-IPv6 Mechanisms[ETCIPv4 to ETCIPv6] and Multihmcost6 is the host connected to a single network whereas in case of multi homing the host is connected to multiple heterogeneous or homogenous network. In ETCIPv4 to ETCIPv6 we have predicted and estimated cost estimation model for a single host when it is connected to only one type of network, whereas in Multihmcost6 approach can speed up the IPv4/IPv6 migration faster and however the overall migration cost is either relatively low, medium or high depending on our assumptions and basic requirements. We have also proposed(Multicost6) one more method which supports when a node is connected to multiple heterogenous or homogenous networks. In this research manuscript the Multihomed network environment (Multihmcost6) expenses estimation and prediction model is shown in Figure. 2. Figure. 3. shows an ER Diagram(Entity Relationship Diagram) of Multihmcost6. Our proposed methodology of IPv4/IPv6 multi homing transition technical/economical expenses estimation and prediction model(Multihmcost6) consists of five basic components which are listed as follows.

3. Experimental Results

In this research work we have collected data from Literature survey(review), an Internet service providers(ISPs), and RFC responses. We have also planned and collected data from the other four categories of Internet service providers like Local Internet service providers, Regional Internet service providers, National Internet service providers, International Internet service providers. Our main intension was to collect and secure the current status and future status of IPv6 products and services and an adoption rates of IPv6 by users, potential expenses and various applications of IPv6, and any roadblocks and/or innovation barriers that exist in today's market. Figure. 1. shows methodology of the Node Multi homing based Multihmcost6 Technique. Fig. 2. shows the Multi homing network Infrastructure using Multihmcost6. Fig. 3. shows an Entity Relationship(ER) diagram for Multihmcost6. Fig. 4. shows Multihmcost6 Total and an Average transition expenses for hardware group. The experimental results for various types of Stake holders groups such as Hardware Group, Software Group, Internet Group and ISPs are shown in figs 5to8. Fig. 5. shows Multihmcost6 for Total and an Average transition expenses for software group. Fig. 6. shows Multihmcost6 for Total and Average transition expenses for software group, Fig. 7. shows Multihmcost6 for Total and an Average transition expenses for Internet service group, Fig. 8. shows Multihmcost6 for Total and an Average transition expenses for Internet service providers(ISP's) group. The Tables such as Table-1, Table-3, Table-5, Table-7 shows the computation of the Total and Average migration costs for the various groups in Multihmcost6. Table-2 shows qualitative comparison of the proposed methodology(Multihmcost6) with other well known expenses prediction and estimation models for Hardware Group where as Table-4 shows qualitative comparison of the proposed technique(Multihmcost6) with other well known prediction and estimation models expenses for software group, Table-6 shows the Qualitative comparison of the proposed method(Multihmcost6) with other well known expenses prediction and estimation models for Labour category and finally the Table-8 shows the qualitative comparison of the proposed method(Multihmcost6) with other well known expenses prediction and estimation models for other expenses group.

4. Analysis

Like all engineering disciplines, software engineering is driven by the three important major factors such as cost, schedule and quality. In some contexts, cost and quality are considered the primary independent factors, where as schedule can be modeled as cost or considered as an independent variable whose value is more or less fixed for a given cost. The cost of developing a system is the cost of the resources used for the system, which in case of software such as manpower, hardware, software, and other support resources. Generally, the manpower component is predominant as software development is largely labor-intensive and the cost of the computing systems is now quite low. Hence the cost of a software project is measured in terms of person-months, i. e, the cost is considered to be the total number of person-months spent in the project. In order to convert this to a dollar amount, it is multiplied with the dollar cost per person-month. In defining this unit cost for a person-month, the other costs(overheads). In Table-1, and Table-3 and Fig. 1 and Fig. 2. in our Multihmcost6 we have computed the cost of hardware is 10%, the cost of software is 10%, the cost of other costs is 0% and the cost of labour is 80%[16]. The cost of hardware and software are predictable to be cheaper(i. e 10% in Table-1 Table-3 and Fig. 1 and Fig. 2.) since many National and Multinational companies(MNC's) in IT sector business are migrating towards IPv6.

5. Future Scope of the Work.

In this research work we have calculated and designed the expenses estimation model for multi homing approach named such as Multihmcost6. The multihmcost6 has calculated expenses for the stake holders group such as Hardware, Software, Labour, other (Internet and ISP's). The mechanism of deploying IPv6 appears to be a complex and expensive operation. However with dedicated effort, careful planning and choosing a right technique actually makes the transition to IPv6 smooth, safety and easy. Therefore we have concluded migrating from IPv4 protocol to IPv6 protocol is not so easy, straight forward, and ideas to simplify the migration between the two versions have to be standardized. In this research manuscript we have discussed and highlighted the pivot role and status of Multihmcost6 and also how multihmcost6 approach can make it the IPv4/IPv6 node multi homing transition type smooth, safety and easy in a faster manner. However, advantages and applications estimated in this research manuscript are much more subjective than expenses estimated

in the previous proposed research work based on estimations of IPv4/IPv6 transition scenarios cost estimation model because which are based on an Internet applications that are yet to be well defined. In addition, benefit estimates are potentially

conservative because they do not reflect future, next generation applications that may be enabled by IPv6. However, we estimated that efforts to accelerate the deployment of IPv6 beyond the normal replacement of hardware and software have significant cost implications potentially tripling the cost of deployment. This is reflected in the majority of stakeholders responding that government's status and vital role should be in supporting R&D and testing but not taking actions to accelerate adoption.

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7. Conclusions

The improvements designed for IPv6 could provide numerous benefits to Internet users, network administrators, and applications developers among these potential benefits are cost reductions due to improved security and increased efficiency, improvements to existing products and services, and innovations leading to new products and services. In this research work paper, we have discussed and estimated the likely costs(Hardware costs, Software and Operating Systems costs, Labour costs and Other costs) of an IPv4/IPv6 Node Multihoming transition approach(Multihmcost6) for the major stakeholders and the potential benefits. In this paper we have propounded a new scheme for the transition of IPv4/IPv6 expenses paradigm using a Node Multi homing approach (Multihmcost6). It is observed that the current expenses of incremental expenses associated with IPv6 deployment over a 4 year period to be approximately $4 billion because primarily it reflects with increased labour costs associated with the transition. Although the expense estimation from IPv4 to IPv6 for a node multi homing approach(Multihmcost6)appears large they are actually small relative to the overall expected expenditures on IT hardware and software(less than 1%) and even smaller relative to the expected value of potential market applications.

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Appendix

FIGURES

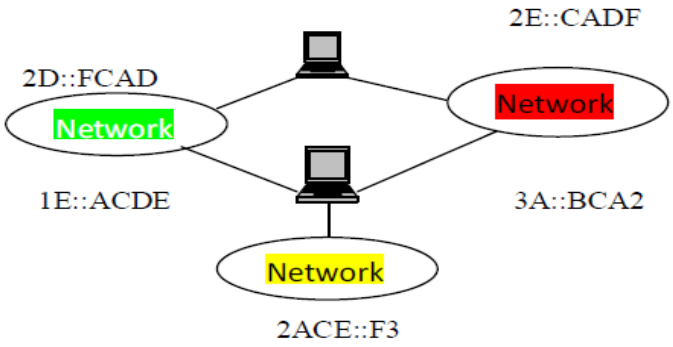

Fig.1 Methodology of Node Multi homing (Multihmcost6) Technique.

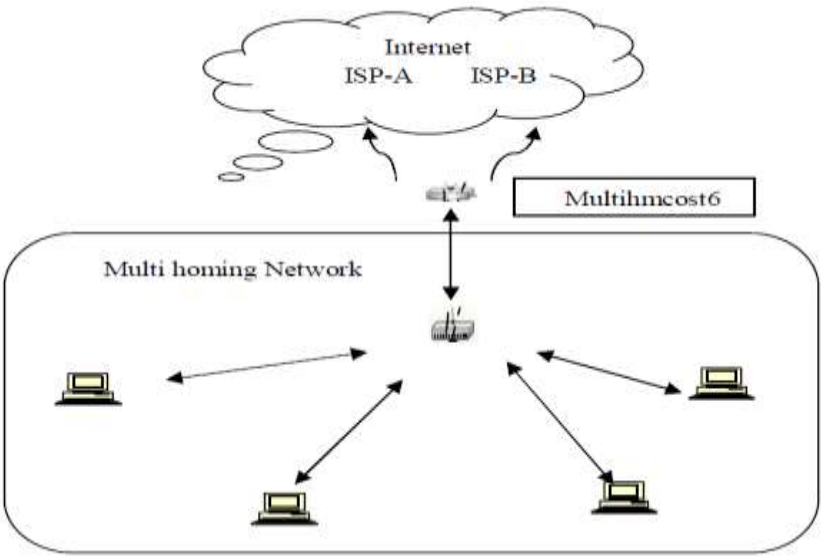

Fig.2 Multi homing network Infrastructure using Multihmcost6.

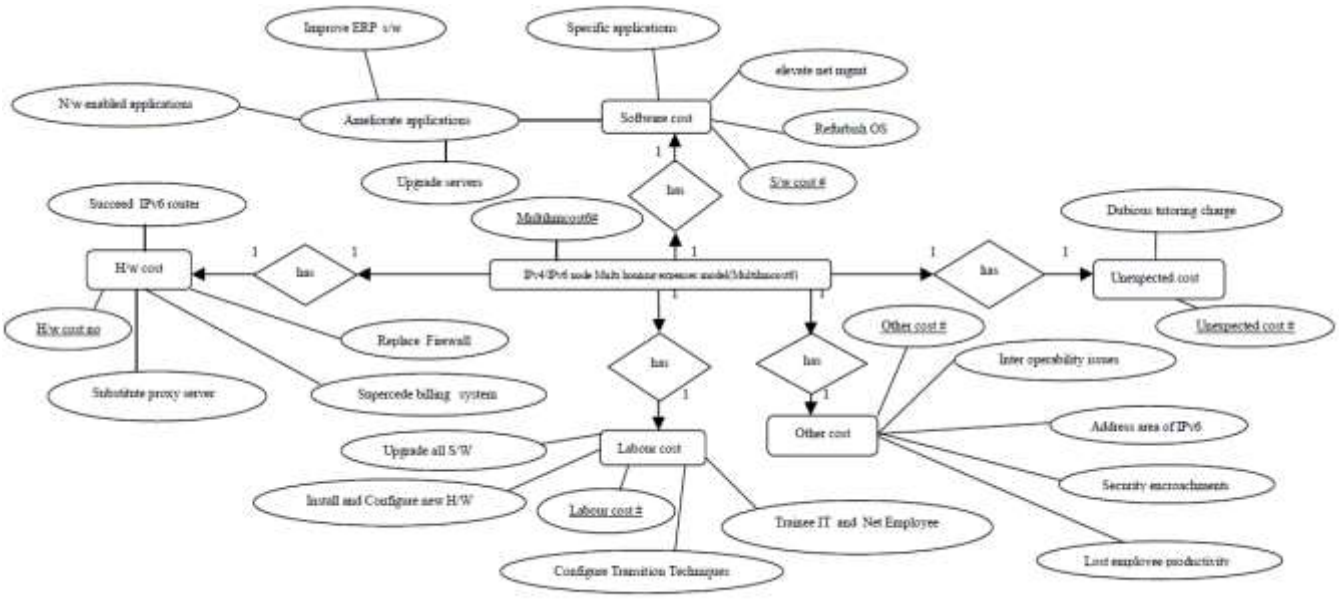

Fig.3 ER Diagram of the Propounded Multihmcost6.

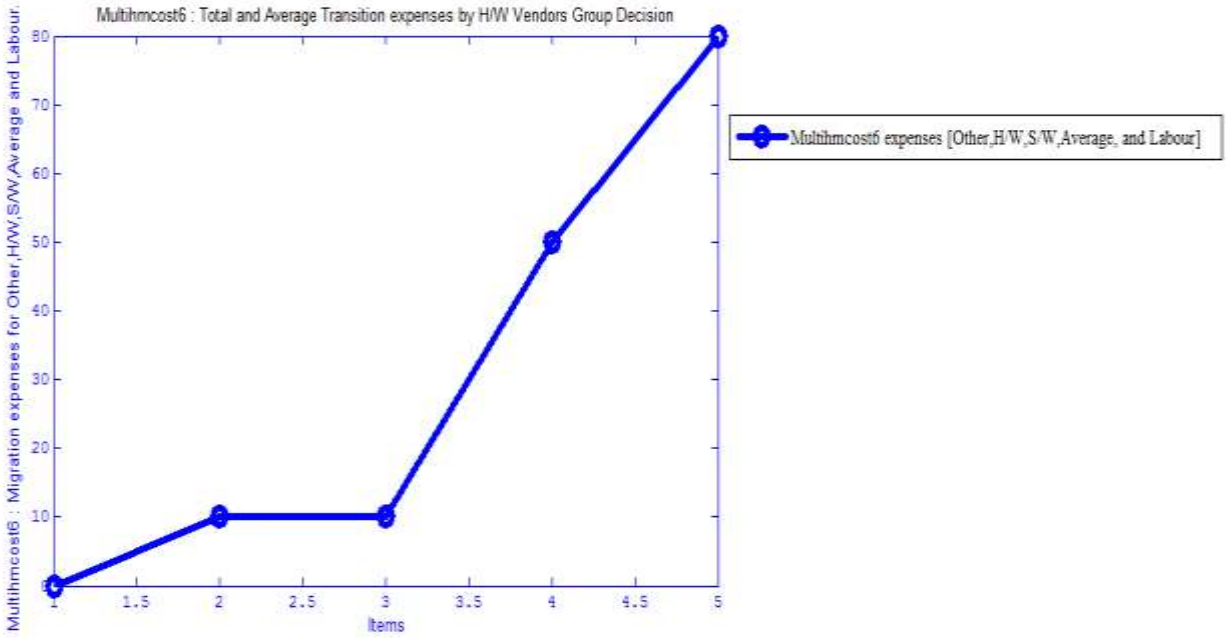

Fig.4 Relative Total and an Average expenses of IPv6 at the Time of Deploying in Node Multi homing approach (Multihmcost6) by the Hardware vendors group (Stakeholder).

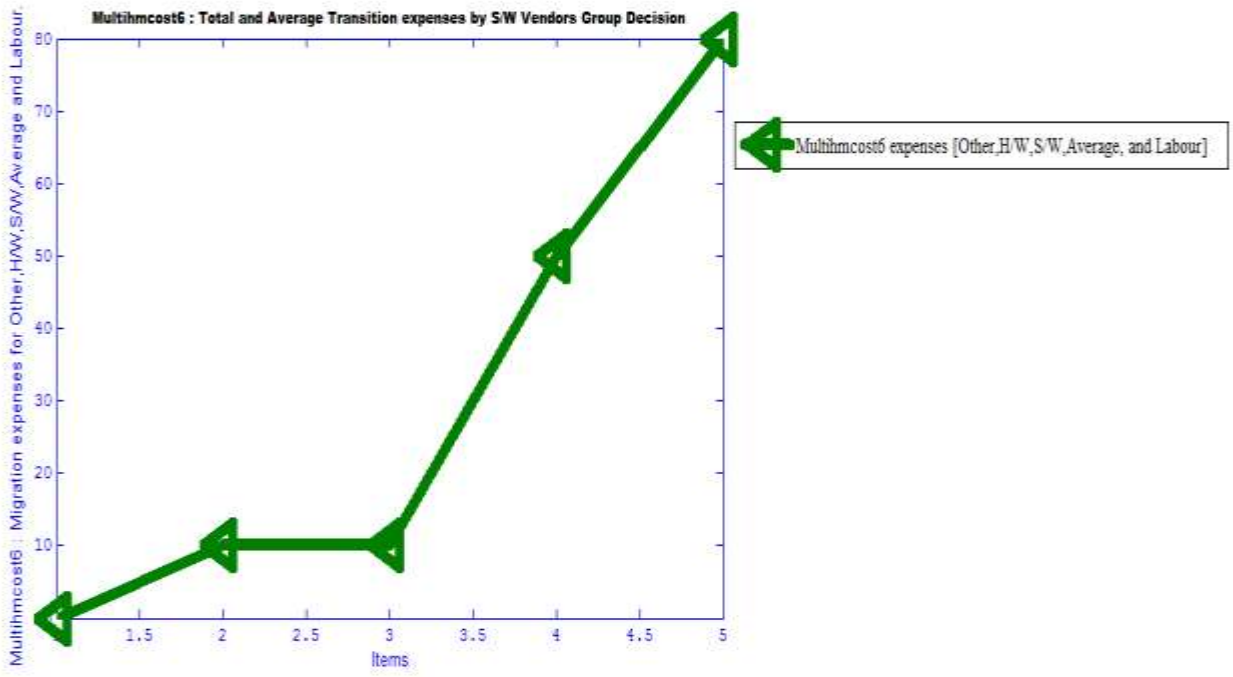

Fig.5 Total and an Average expenses of an IPv6 deployment in Node Multi homing approach(Multihmcost6) by the Software vendors group (Stakeholder).

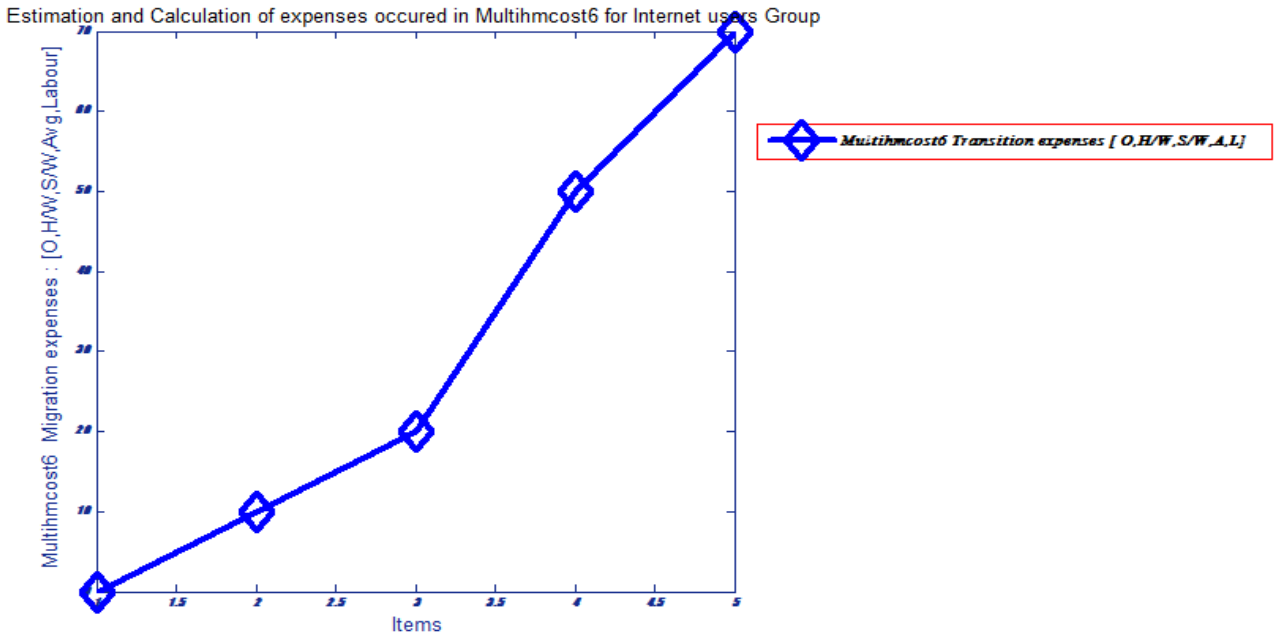

Fig.6 Total and Average expenses of IPv6 deployment in a Node Multi homing approach(Multihmcost6) for an Internet users Group(Stakeholders).

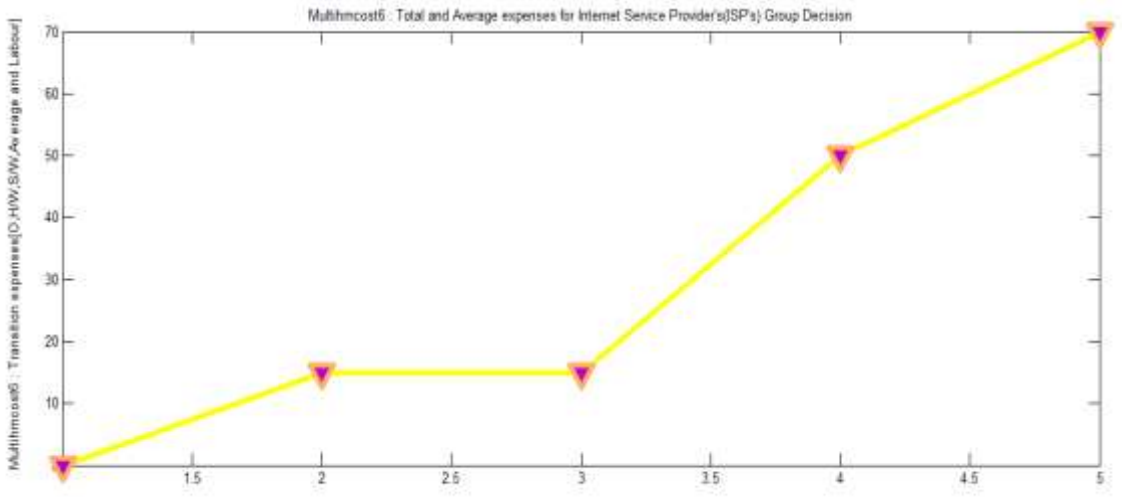

Fig.7 Total and an average expenses of an IPv6 deployment in a Node Multi homing approach(Multihmcost6) by the Stakeholders (ISPs) .

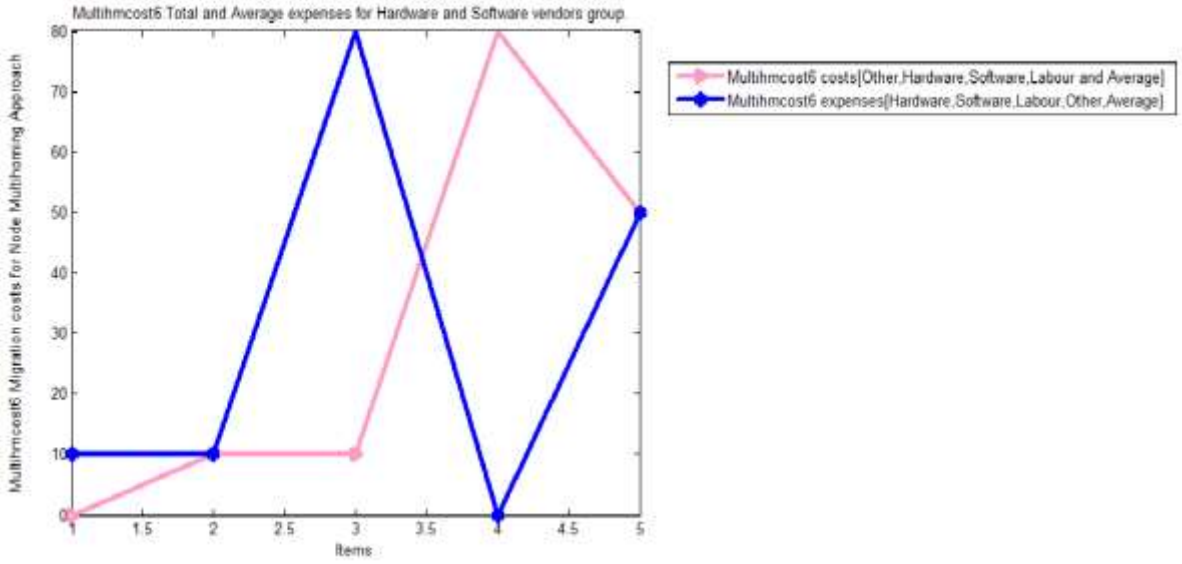

Fig.8 Total and an average expenses of Multihmcost6 for Hardware and Software Group(Multihmcost6) by the Stakeholders (ISPs)

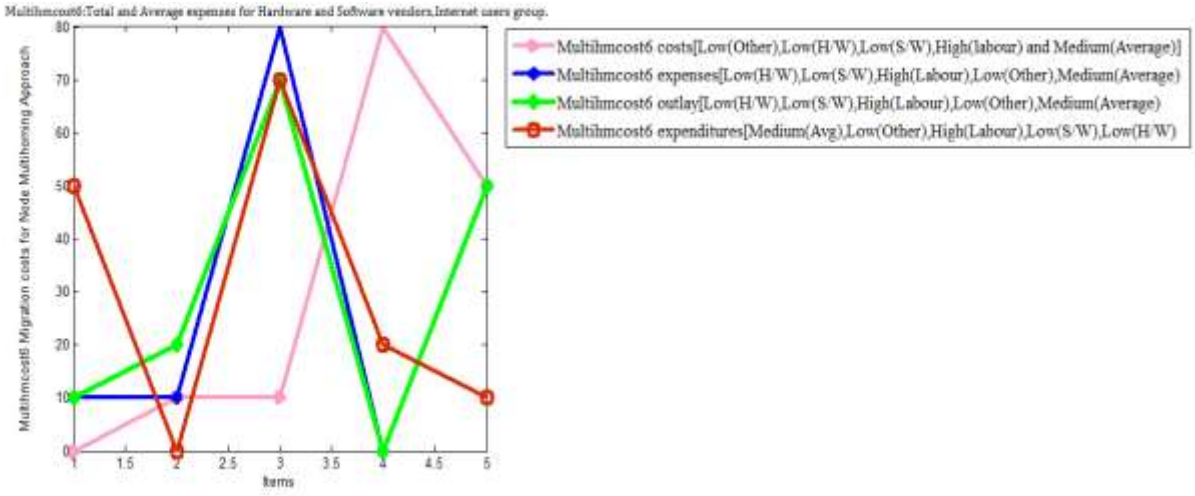

Fig.9 Total and an average expenses of Multihmcost6 for Hardware and Software and an Internet Group (Multihmcost6) by the Stakeholders(ISPs).

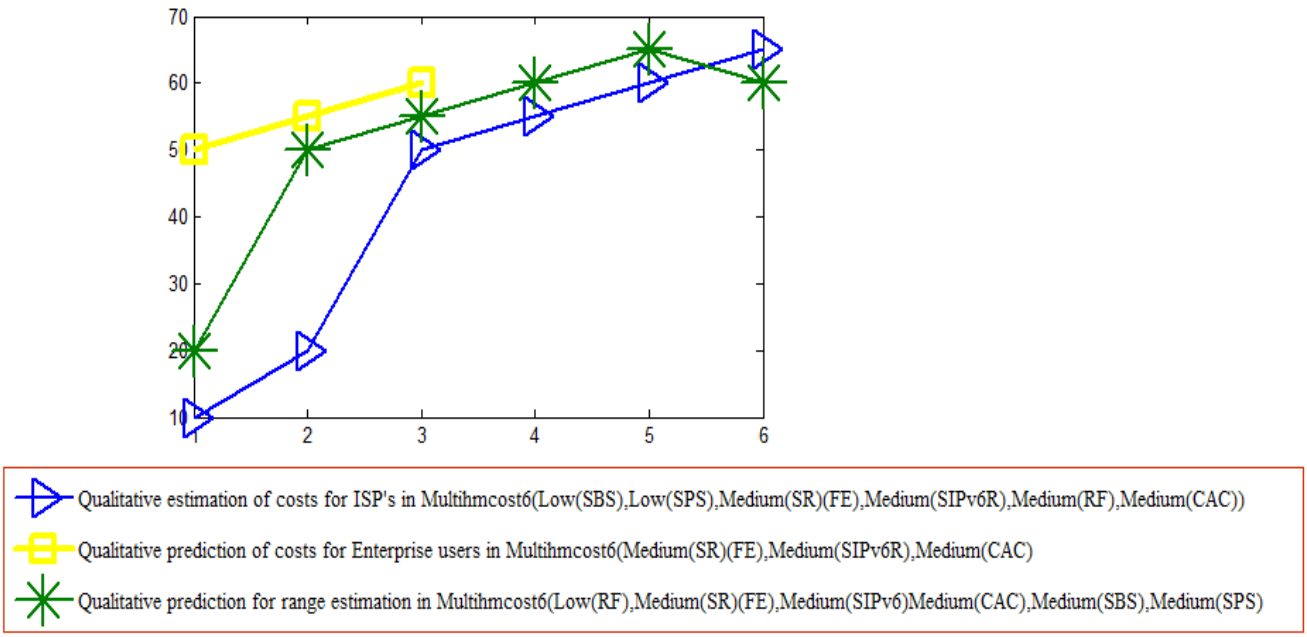

Fig.10 Qualitative Prediction and Estimation of expenses in Multihmcost6 for ISPs, Enterprise users and Range estimation.

TABLES

Table 1:Prediction and estimation of Total and an average expenses for Multihmcost6 by Hardware vendors group.

Sr. No	Multihmcost6 Various expenses.	Multihmcost6 Percentage (%)	Multihmcost6 expenses
1	Hardware	10	Low
2	Software	10	Low
3	Labor	80	High
4	Other	00	Low
5	Average Multihmcost6 expenses.	50	Medium

Table 2:Qualitative comparison of the propounded method (Multihmcost6) with other well known expenses Prediction and an estimation models for Hardware Group.

Sr. No	Multihmcost6 Particulars	Range estimation of Multihmcost6.	ISP's	Enterprise user's.
1	Hardware cost_number	-	-	-
2	Substitution of Router(SR)/Forwarding engine(FE).	Medium	Medium	Medium
3	Succeed IPv6 Router(SIPv6R)	Medium	Medium	Medium
4	Replace Firewall(RC)	Low	Medium	----------
5	Come after Chassis when line cards will not fit	Medium	Medium	Medium
6	Supercede Billing Systems(SBS).	Medium	Low	-
7	Substitute of Proxy Server(SPS).	Medium	Low	-

Table 3:Possible estimation and computation of a Total and an Average expenses of Multihmcost6 by software vendors group.

Sr. No	Multihmcost6 costs.	Multihmcost6 Percentage (%)	Multihmcost6 Weights.
1	Hardware	10	Low
2	Software	10	Low
3	Labor	80	High
4	Other	00	Low
5	Average recognition total costs	50	Medium

Table4:Qualitative comparison of the proposed method(Multihmcost6) with other well known expenses prediction and estimation models for Software vendors group.

Sr. No	Multihmcost6 different expenses.	Multihmcost6 Per (%)	Integrated Devices, Components and Worker cost
1	Hardware	10	Low
2	Software	20	Low
3	Labor	70	High
4	Other	00	Low
5	Avg Multihmcost6 expenses.	50	Medium

Table 5:Total and an average migration costs for an Internet users group(Multihmcost6).

Sr. No	Multihmcost6 different expenses.	Multihmcost6 Per (%)	Integrated Devices, Components and Worker cost
1	Hardware	10	Low
2	Software	20	Low
3	Labor	70	High
4	Other	00	Low
5	Avg Multihmcost6 expenses.	50	Medium

Table 6:Qualitative Comparison of the Propounded Method(Multihmcost6) with other well known expense Prediction and estimation models for Labour group.

Sr. No	Item's	Price calculation in Multi homing approach.	ISP's	Enterprise user's
1	Labour_cost_number	-	-	-
2	Traine IT or Network Professionals.	Low	Low	Low
3	Creating and Designing IPv6 Strategy and a Network vision.	Medium	Medium	Small
4	Implementation of IPv4/IPv6 Transition	-	-	-
4.1	Install and Configure of any new Hardware.	-	-	-
4.2.	Maintain new system	-	Low	Low
4.3.	Upgrade of all Software	-	Small/Medium	Small(S)/Medium
4.4.	Configure IPv6 Transition techniques like Dual stack, Tunneling, Header Translation etc	Medium	Medium	Medium
4.5	Extensively test before "going live" with IPv6 applications.	Low	Low	Low

Table 7:Computation of Total and an Average expenses of IPv4/IPv6 in Node Multi homing Transition (Multihmcost6) for ISP's group.

Sr. No	Categories of Multi homing transition expenses (Multihmcost6)	Percentage(%)	Range of expenses of Multihmcost6
1	Hardware	15	Low
2	Software	15	Low
3	Labor	70	High
4	Other	00	Low
5	Average recognition total costs	50	High

Table 8:Qualitative comparison of the propounded method (Multihmcost6) with other well known expenses prediction and estimation models for other expenses group.

Sr. No	Item's	Range of cost in Multihmcost6	ISP's	Enterprise user's.
1	Other costs_number	-	-	-
2	IPv6 address block(s).	High(H)	Small(S)	Small
3	Lost employee productivity	Medium	Medium(M)	Small
4	Security intrusions	High	Low(L)	Low
5	Foreign activities	Medium	Medium	Medium
6	Interoperability Issues	Small	Medium/Low	Medium/Low

Table 9:Break down of Infrastructure Items and an associated cost values and its annual spending on IT staff and Training.

Sr. No	Network Items.	Range of Multihm cost6.	Multihm cost6 average price in Dollar($)	Number of Units Required for Multihm cost6	Avg estimated expenses/ expense of each unit. (1US$=56.00 INR)	Total expenses in Indian rupees
1	Router	Low	$10,000	16	56,000=00	8960000=00
2	Distribution Switches	Medium	$8,000	200	448000=00	89600000=00
3	Firewall	Low	$1,000	08	56000=00	448000=00
4	Network Specialist	High	$45,000	12	2520000=00	30240000=00
5	Additional Training	Low	$2,000	08	112000=00	896000=00
6	Low end Desktop Workstations	Low	$1,000	10	56000=00	5,60000=00
7	High End Power PC with Latest configuration of Licensed software installation with laser HP printer	Low	$3,000	05	168000=00	840000=00
8	Simple network setup(CAN) accessories for real 4G network	Low	$2,000	10	112000=00	1120000=00
9	Licensed Matlab Latest version release,GNU Linux,Simulation Package and Visual studio software.	Low	$3,000	08	168000=00	8960000=00
10	Nitek Video Receiver 16 port hub	Low	$9,31.09	02	52139.36	104278.72
11	24 port hub	Low	$950	08	56050.00	448400.00
12	Modem	Low		01		
13	SD208 10/100Mbps 8-Port Switch	Very Low	$27	10	1512=00	15120=00
14	SD208 10/100Mbps 16-Port Switch	Very Low	$75	10	4200=00	42,000=00
15	SD2008 10/100/1000 Mbps Gigabit Switch	Very Low	$76	10	4256=00	42560=00