A Multi Homing Based IPv4/IPv6 Migration Expenditure Model: Multicost6

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Abstract: **In this research work we investigate an innovative economical and technological IPv4/IPv6 a novel multi homing migrational model named 'Multicost6'. The 'Multicost6' offers innovative economical and technological charges like the first one is the real amount of hardware which indicates an economical value and second one is real rate of software like training cost and the third one is labour outlay and fourth one is an un anticipated charge and fifth one is named such as another cost required for multi homing transition. The availability of two or more connectivity providers (configuration known as multi homing) allows improvements in failure tolerance and enables traffic engineering capabilities. Multi homing allows a site/node to connect to multiple Internet service providers (ISPs) simultaneously. The proposed solution consists of multiple mechanisms that provide different benefits to the multi homed site. In this approach,each multi homed host is assigned multiple prefixes from its upstream providers,and it creates the interface identifier part of its addresses. With the advantages of the eased renumbering network mechanism and the large addressing space introduced by IPv6 network,multi homing will become much more popular. In this innovative research work we have propounded a technical and an economical expenditure estimation model(Multicost6) for Hardware,Software,Labour,Un anticipated and Other costs for University of Mysore(DoS in CS,Manasagangotri,Mysore-6) and Mangalore University(Department of CS,Mangalagangotri,Mangalore) in INDIA. The experiment was organized for various sizes of LAN's with different size digital computers such as Desktop machines,Laptops,Main frame computers,Mini computers,Super computer etc to study and analyze the effect of charge estimation model(Multicost6) for multi homing technique and the results proves that multicost6 expense estimation model for multi homing host is Low,Medium and High based on Hardware,Software,Labour and Other expenditure estimation factors. In order to Plot Bar chart,Pie chart we used Matlab 7.11.0(R2010b) and to compute Simulation results we have also adopted NS2.**

General terms: IPv4; IPv6; Multi homing; Transition etc.

Keywords: Cost; Multicost6; Hardware; Labour; Software; Unpredictable cost etc.

I. INTRODUCTION

The concept of Multicost6 is a mechanism that comes in transition of IPv4/IPv6 for multi homing hosts. Developing a rate estimation model for IPv4/IPv6 multi homing transition is a difficult task because it is not only dependent on only one expenditure 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 economical and technical expenditures for the transition of IPv4/IPv6.

Guy almes described the cost of IPv6 deployment (Hardware expenses for transition of Pv4/IPv6 and implications for IPv6 migration are less easily defined). He has estimated and computed different categories of transition prices and considerations. He has also worked on coexistence of dual protocols. The concept of multi homing host is shown in Fig.1.

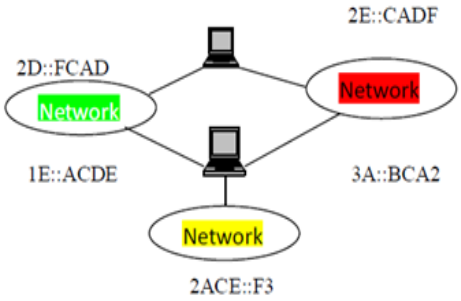

Fig. 1 Concept of Multi homing host.

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[27]. 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.

Technical and economic assessment of Internet protocol version 6(IPv6) discussion draft[26] also explains adoption of IPv6 can potentially produce measurable benefits for

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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 [26][29].

II. PROPOUNDED METHODOLOGY

The Proposed ER(Entity Relationship) diagram of Multicost6 is shown in Figure.2. Our proposed IPv4/IPv6 Multi homing Transition technical/economical expenditure prediction model consists of five basic components which are mentioned as follows.

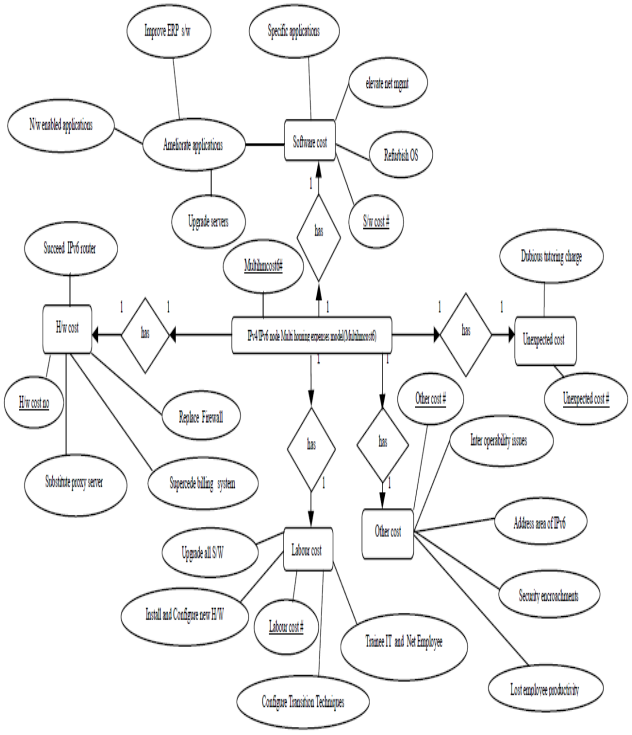

Fig. 2 ER Diagram of the propounded Multicost6.

1.Hardware expenditures.

2.Software and operating system expenses.

3.Training amounts.

4.Unpredictable charges.

5.Other prices.

A. *Hardware expenditures:*

The first type of multihoming transition cost factor in cost estimation model is hardware cost which is also a vital element. In order to design hierarchy of IPv6 Multi homing transition cost estimation model for the two beautiful reputed universities like University of Mysore and Mangalore University by using economic assessment approach[26],hardware costs,software and operating system costs,training costs,unpredictable costs etc are really playing an important role. Hardware costs mainly consist 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. Specifically high-end routers,switches,memory and firewalls all will need to be upgraded to enable large scale IPv6 use within a network[26][20]. Firewall hardware is also one of the important security issues 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[26]. The hardware cost is also dependent on the level of IPv6 usage(i.e hardware $\boldsymbol{\alpha}$ level of IPv6).

IPv6 transition levels are broadly categorized into 3 types like Dual Stack,Tunneling issues,Header translation etc.The various types of Hardware costs,Software costs, Labour costs and Other costs in different phases of transition are explained very briefly[26]. The Hardware costs in various phases 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 is very high[26]. 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 figured 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 1+ backbone routers or replacing firewall is medium(M). So this type of cost is said to be hardware costs[26]. Therefore we have decided and confirmed that hardware cost in tunneling transition phase is medium. So in order to compute

Multi homing transition costs for tunneling network is[26]:

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.

TotalHardwarecosts=10%(Hardware)+10%(Software)+80%(Labour costs)+0%(Other costs)

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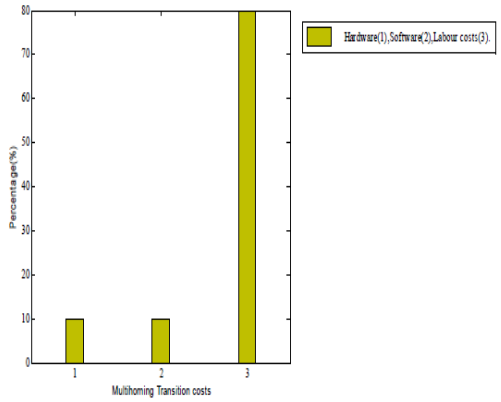

Fig. 3 Predicted Multi homing Transition total cost model(Multicost6) for Dual stack,Tunneling and Header Translation in University of Mysore(DoS in CS,Manasagangotri) and Mangalore university(Dept of CS,Mangalagangotri).

TABLE-I: IDENTIFICATION OF TOTAL COST OF MULTICOST6 FOR HARDWARE VENDORS GROUP[26].

Sl.No	Type of Multihoming transition costs.	Percentage(%)
1	Hardware	10
2	Software	10
3	Labour	80
4	Other	00
5	Average recognition total costs	50

Total costs can also be shown by using Bar chart in Fig. 1

The Table-2 shows the hierarchy of multicost6 according to the stake holders group[26][20].

TABLE-II:IPV4/IPV6 BASED MULTI HOMING TRANSITION HARDWARE COST ESTIMATION MODEL(MULTICOST6) IN UNIVERSITY OF MYSORE(DOS IN CS,MANASAGANGOTRI) AND MANGALORE UNIVERSITY(DEPT OF CS,MANGALAGANGOTRI).

Sl.No	Particulars	DoS in CS in University of Mysore and Dept of CS in Mangalore University cost range in Multihoming approach.	ISP's	Enterprise user's.
	Hardware			
1	Substitution of Router/Forwarding engine.	(n*m)=nm	(n*m)=nm	(n*m)=nm
2	Succeed of Firewall.	(n*m)=nm	(n*m)=nm	(n*m)=nm
3	Replacement of NIC/Line cards.	(n*l)=nl	(n*m)=nm	----------
4	Come after Chassis when line cards will not fit	(n*m)=nm	(n*m)=nm	(n*m)=nm
5	Supercede of Billing systems.	(n*m)=nm	(n*l)=nl	----------
6	Substitution of Proxy Server.	(n*m)	(n*l)=nl	----------

Where m:Medium,l:Low,h:High,s:Small,n:n Number of machines connected to the multiple networks,nh:Highest Multi homing migration cost for n number of nodes,nl:Lowest Multi homing migration cost for N number of nodes,ns:Smallest multi homing transition cost for n number of nodes,nm:Medium Multihoming transition cost for n number of nodes.

B. The software expenses:

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 upgradation 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 microsystems[26][20].

TABLE-III:COGNITION AND RECOGNITION OF MULTICOST6 FOR SOFTWARE VENDORS GROU

Sl.No	Type of Multihoming transition costs.	Percentage(%)
1	Hardware	10
2	Software	10
3	Labour	80
4	Other	00
5	Average recognition total costs	50

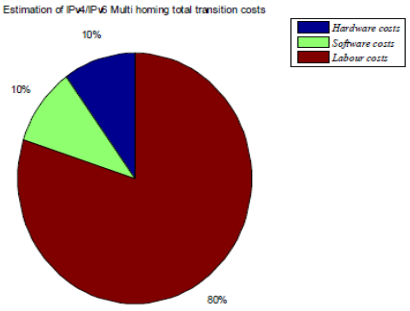

Fig. 4 Predicted Multi homing transition Total cost model (Multicost6) for Dual Stack,Tunneling and Header translation in University of Mysore (DoS in CS,Manasagangotri) and Mangalore University(Dept of CS,Mangalagangotri).

The transition phases in IPv4/IPv6 are broadly categorized into 1.Dual stack,2.Tunneling and 3.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 the 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.

TABLE-IV: IPV4/IPV6 MULTI HOMING TRANSITION SOFTWARE COST ESTIMATION MODEL IN UNIVERSITY OF MYSORE(DOS IN CS,MANASAGANGOTRI AND MANGALORE UNIVERSITIES(DEPT OF CS,MANGALAGANGOTRI).

Sl.No	Particulars	DoS in CS in University of Mysore and Dept of CS in Mangalore University cost range in Multihoming approach.	ISP's	Enterprise user's.
	Software			
1	Upgradation of Network monitoring/Management Software.	(n*h)=nh	(n*l)=nl	(n*l)=nl
2	Upgrading of OS.	(n*l)=nl	(n*m)=nm	(n*s)=ns
3	Upgradation of Applications like Servers(Web,DNS,FTP,Mail,Music,Video etc.	(n*l)=nl	(n*m)=nm	----------
4	Upgradation of Applications like ERP(Peoplesoft,Sybase,Oracle,VB,Informix,ASP etc).	(n*h)=nh	(n*m)=nm	(n*m)=nl
5	Other organization specific network enabled applications.	(n*m)=nm	(n*l)=nl	(n*l)=nl

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Where m:Medium,l:Low,h:High,s:Small,n:n Number of machines connected to the multiple networks,nh:Highest Multi homing migration cost for n number of nodes,nl:Lowest Multi homing migration cost for N number of nodes,ns:Smallest multi homing transition cost for n number of nodes,nm:Medium Multihoming transition cost for n number of nodes.

C. Labour Costs(Training amounts):

The Third one more important cost estimation factor to analyze and calculate multi homing IPv4/IPv6 transition issue is labour costs. Labour 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[26][20]. Based on our research results training cost is one of the most significant upgradable costs. The labour cost is mainly based on the level of understanding the network administration staff.

Therefore we can also conclude

i.e[Labour cost **α** Level of understanding(grasping power) network admin]. Training cost factor for large size organizations will be minimal with existing IPv6 expertise[17].

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 of employees on hired basis in order to install and configure a new hardware,software,dual stack network,transition mechanism and to address novel additional security mechanisms. The actual labour cost mainly depends on the level of understanding the necessary equipments for network administration staff.During the time of a short tenure the labour costs also depend on the additional network administration costs[17].

2.**Dual stacks**:The labour costs in tunneling phase are 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.

TABLE-V: DETERMINATION OF TOTAL COST OF MULTICOST6 FOR INTERNET USERS GROUP.

Sl.No	Type of Multihoming transition charges.	Percentage(%)
	Hardware	10
2	Software	20
3	Labour	70
4	Other	00
5	Average recognition total costs	50

The Fig .5. shows the Multi homing total cost estimation model((Multicost6) of IPv4/IPv6 for various levels of Transitionaccording to the predictions and Expectations of Internet users.

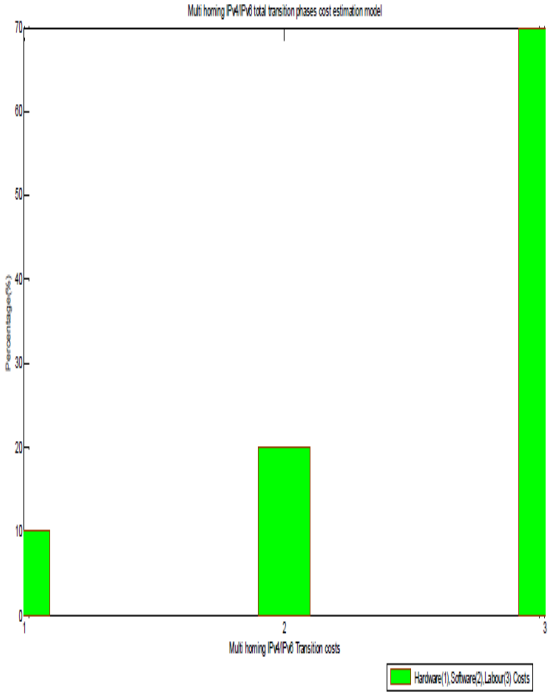

Fig. 5 Predicted Multi homing Transition Total cost model(Multicost6) for Dual Stack,Tunneling and Header translation in University of Mysore(DoS in CS,Manasagangotri) and Mangalore University (Dept of CS,Mangalagangotri).

TABLE-VI:IPV4/IPV6 MULTI HOMING TRANSITION LABOUR COST ESTIMATION MODEL(MULTICOST6) IN UNIVERSITY OF MYSORE (DOS IN CS,MANASAGANGOTRI AND MANGALORE UNIVERSITY(DEPT OF CS,MANGALAGANGOTRI).

Sl.No	Particulars	DoS in CS in University of Mysore and Dept of CS in Mangalore University cost range in Multi homing approach.	ISP's	Enterprise user's.
	Labour			
1	Providing trainee for IT or Network Professionals.	(n*l)=nl	(n*l)=nl	(n*l)=nl
2	Designing IPv6 Strategy and a Network vision.	(n*m)=nm	(n*m)=nm	(n*s)=ns
3	Implementation of IPv4/IPv6 Transition	----------	----------	----------
3.1	Installation and Configuration of any new Hardware.	----------	----------	----------
3.2.	Maintenance new system	----------	(n*l)=nl	(n*l)=nl
3.3.	Upgradation of all Software	----------	(n*s/m)=ns/m	(n*s/m)=ns/m
3.4.	Configuration of IPv6 Transition techniques like Dual stack,Tunneling,Header translation etc	(n*m)=nm	(n*m)=nm	(n*m)=nm
3.5	Extensively test before "going live" with IPv6 applications.	(n*l)=nl	(n*l)=nl	(n*l)=nl

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Where m:Medium,l:Low,h:High,s:Small,n:n Number of machines connected to the multiple networks,nh:Highest Multi homing migration cost for n number of nodes,nl:Lowest Multi homing migration cost for N number of nodes,ns:Smallest multi homing transition cost for n number of nodes,nm:Medium Multihoming transition cost for n number of nodes.

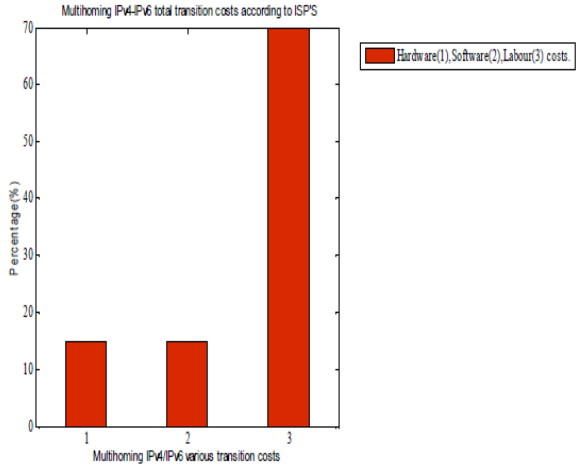
D. Other costs:

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 of Multicost6 migration levels such as dual stack and tunneling and header translation are listed as follows.

1.Security threat effects in Tunneling as well as in Dual stack phases[26].

TABLE-VII:RECOGNITION OF TOTAL COST OF IPV4/IPV6 MULTI HOMING TRANSITION(MULTICOST6) FOR ISP'S GROUP

Sl.No	Type of Multihoming transition Prices.	Percentage(%)
1	Hardware	15
2	Software	15
3	Labour	70
4	Other	00
5	Average recognition total costs	50



The Fig. 6 Shows the estimation of IPv4/IPv6 transition phases total costs according to ISP's

1.IPv6 address block(s),2.Lost employee productivity,3.Security intrusions,4.Foreign activities,5.Interoperability Issues.Unexpected threat like security intrusion is considered to be one of an example for other costs[17].

Where m:Medium,l:Low,h:High,s:Small,n:n Number of machines connected to the multiple networks,nh:Highest Multi homing migration cost for n number of nodes,nl:Lowest Multi homing migration cost for n number of nodes,ns:Smallest multi homing transition cost for n number of nodes,nm:Medium Multihoming transition cost for n number of nodes.

TABLE-VIII:IPV4/IPV6 MUTI HOMING TRANSITION AND OTHER COST ESTIMATION MODEL IN UNIVERSITY OF MYSORE(DOS IN CS,MANASAGANGOTRI AND MANGALORE UNIVERSITIES(DEPT OF CS,MANGALAGANGOTRI).

Sl.No	Particulars	DoS in CS in University of Mysore and Dept of CS in Mangalore University cost range in Multi homing approach.	ISP's	Enterprise user's.
	Other costs			
1	IPv6 address block(s)	(n*h)=nh	(n*s)=ns	(n*s)=ns
2	Lost employee productivity	(n*m)=nm	(n*m)=nm	(n*s)=ns
3	Secuurity intrusions	(n*h)=nh	(n*l)=nl	(n*l)=nl
4	Foreign activities	(n*m)=nm	(n*m)=nm	(n*m)=nm
5	Interoperability Issues	(n*s)=ns	(n*m/l)=nm/l	(n*m/l)=nm/l

TABLE-IX: BREAK DOWN OF INFRASTRUCTURE PARTICULARS AND ASSOCIATED PRICE VALUE OWNED BY UNIVERSITY OF MYSORE(DOS IN CS,MANASAGANGOTRI AND MANGALORE UNIVERSITIES(DEPT OF CS,MANGALAGANGOTRI) AND ITS ANNUAL SPENDING ON IT STAFF AND TRAINING .

Sl. No	Network particulars	Price range	University of Mysore/Mangalore University avg price in Dollar($)	Number of units required.	Avg estimated Charge/Cost of each unit.(1 $=56.00INR)	Total Charge in Indian rupees
1	Router	High	$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 speacialist	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 licenced software installation with laser HP printer	Medium	$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.	Medium	$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	Medium	$76	10	4256=00	42560=00

III. SIMULATIONS IN NS2

NS2(Network Simulator Version 2) developed by UC Berkeley is a kind of open-source free software simulation platform in allusion to network technology[21][22][24][25]. It's essentially a discrete event simulator[25][21][22]. There are 2 levels in the simulation of NS2 one is based on configuration and construction of Otcl,which can use some existing network elements to realize the simulation by writing the Otcl scripts without modifying NS2 the other one is based on C++ and Otcl. Once the module resources needed do not exist,NS2 must be upgraded or modified to add the required network elements[25]. Under these circumstances,the split object model of NS2 is used to add a new C++ class and an Otcl class,and then program the Otcl

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scripts to implement the simulation. The basic architecture or main components of NS2 are shown in Fig.2.NS2 now has become one of the first selected softwares to implement network simulation in the academic field[25][24].

TABLE-X: THE BASIC ARCHITECTURE OR MAIN COMPONENTS OF NS2.

Event Scheduler	NS2
Tclcl	Network component
Otcl	
Tcl/Tk	

A. *The basic components in NS2*

NS2 simulation can be divided into two layers. At first we should analyze which layer is involved before the network simulation. One layer is based on OTcl programming. There are no needs to modify NS2 itself to implement simulation by use of existing network elements of NS2,just to compile OTcl scripts. Another layer is the one based on C++ and OTcl programming[23][24][25]. If there aren't required network elements in NS2, it's needed to extend NS2,adding required ones which also mean adding new C++ and OTcl class,then to compile OTcl script. The simulations were performed using Network Simulator 2(Ns-2),particularly popular in the wired networking community. The traffic sources are CBR(continuous bit–rate). The source-destination pairs are spread randomly over the network. The wired network model uses 'random waypoint model' in a rectangular filed of 500mx500m with 50 nodes. During the simulation,each node starts its journey from a random spot to a random chosen destination. Once the destination is reached,the node takes a rest period of time in second and another random destination which is chosen after that pause time. This process repeats throughout the simulation,causing continuous changes in the topology of the underlying network. Different network scenario for different number of nodes and pause times are generated[25]. The various simulation parameters in NS2 for the multi homing transition of IPv4/IPv6 experiment are shown in Table-11[17][21][22][23][24][25].

TABLE-XI: SIMULATION PARAMETERS.

Sl. No	Parameter	Value
1	*Simulator*	Ns-2
2	Simulation time	200 s
3	Simulation area	500X500
4	Transmission range	250 m
5	Bandwidth	2Mbps
6	Traffic type	CBR
7	Data payload	Bytes/packet

IV. DISCUSSIONS AND CONCLUSIONS

In this paper we have proposed,expenditure assessement model for the transition of IPv4/IPv6 with the use of multi homing transition features such as "multicost6". It is observed that using the proposed method one can achieve a good charge estimation model compared to the other cost valuating schemes in transition of IPv4/IPv6. Estimation of multi homing transition amount(Multicost6) plays an important role in transition of IPv4/IPv6 applications. Devising multi homing charge estimation model for transition of IPv4/IPv6 applications is really a challenging issue. In this study we can analyze characteristics of IPv4/IPv6 multi homing transition expenses appraisal model named "multicost6". The multicost6 predicts that charge estimation model for transition of IPv4/IPv6 multi homing transition is either low,medium,and high depending upon the hardware,software,labour charges and other expenses. According to the predictions and suggestions of hardware vendors,software vendors,Internet users and ISP's we can also estimate the various categories of hardware,software,labour and other prices like low,medium and high. The proposed method is very simple to estimate cost assessment model(Multicost6) when any node is connected to more than one similar or dissimilar network. The experimental results have displayed the novelty of the above mentioned method which is easy to identify the charge estimation for hardware,software,labour and other prices.

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REFERENCES

[1] S.Deering and R.Hinden "Internet Protocol Version 6(IPv6) Specification", RFC 2460, December 1998.

[2] Atul Kahate, "Cryptography and Network Security", Tata McGraw-Hill, 2003, pp-8-10.

[3] Kurose. J. & Ross. K. (2005) Computer Networking: A top-down approach featuring the Internet. 3rd ed, (Addison Wesley).

[4] John. J. Amoss and Daniel Minoli, Handbook of IPv4 to IPv6 Transition: methodologies for institutional and Corporate Networks, Auerbach Publications.

[5] Tim Rooney, IPv4-to-IPv6 Transition Strategies, BT Diamond IP, Feb 2007.

[6] S.G.Glisic, Advanced Wireless Communications, 4G Technology., John Wiley Chichester, 2004.

DOI: 10.5963/IJCSAI0203003

[7] Mark Grayson, Kevin Shatzkamer, Scott wainner, IP Design for Mobile Networks.

[8] S.Tanenbaum, "Computer Networks", Third Edition, Prentice Hall Inc., 1996, pp. 686, 413-436, 437-449.

[9] Behrouz A. Forouzan, Third Edition, "TCP/IP Protocol Suite"

[10] [Multihoming IPv6]-Multihoming with IPv6, Troels Walsted Hansen. I. Tromso University-Norway,Dec 21, 2001, Thesis.

[11] J.Abley , B. Black, and V. Gill, "Goals for IPv6 Site Multi homing Architectures", RFC 3582, IETF, August 2003.

[12] F.Baker and P. Savola, "Ingress Filtering for Multihomed Networks", BCP 84, IETF, March 2004.

[13] Ioan R., Sherali Z. 2003. "Evaluating IPv4 to IPv6 Transition Mechanism". IEEE, West Lafayette, USA, v (1): 1091-1098.

[14] Daniel G., Fangzhe C.2002.Realizing the Transition to IPv6. IEEE communication magazine, June, vol. 6, issue 3: 138-148.

[15] Hossam A., Laurent T. 1999. Methods for IPv4-IPv6 Transition. The Fourth IEEE Symposium on Computers and Communications, France, 478-484.

[16] Kai W., Ann-Kian Y. A.L.Ananda.2001. DTTS: A Transparent and Scalable Solution for IPv4 to IPv6 Transition.IEEE. Singapore, 248–253.

[17] Arano, Takashi. June 2003. "IPv6 Market Opportunities—Real Business Challenges in Japan" Presented at the U. S. IPv6 Summit.

[18] RTI International for National Institute of Standards & Technology, Planning Report 05-2: IPv6 Economic Impact Assessment, October 2005.

[19] RFC3178 Hagino,J.and H. Snyder, "IPv6 Multi homing Support at Site Exit Routers, "-RFC 3178, October 2001.

[20] Hanumanthappa. J., Dr. Manjaiah.D. H., Kumar. B.I.D, in: NCWCT-09:Proceedings of National Conference on Wireless Communications and Technologies(NCWCT-09).

[21] Network Simulator(NS), version2, "http://www. isi. edu/nsnam/ns".

[22] Mobiwan: NS-2 extensions to study mobility in Wide-Area IPv6 etworks, "http://www.inrialpes. fr/planete/mobiwan

[23] NS2 tutorial running simulations by Matthias Transier.

[24] Mahmood Hasanlou, "Introduction to mobility and network simulator 2".

[25] www. isi. edu/nsnam/ns/tutorial Marc Greis tutorial on ns2

[26] Technical and economic assessment of Internet Protocol Version 6(IPv6) discussion draft.

[27] Nathan Robinson, Cesar Ramos, P.E., Jose Luis Jara, "Enterprise Perspective on IPv6 Transition Mechanisms".

[28] Tomás P. de Miguel and Eva M. Castro, "Programming guidelines on transition to IPv6"

[29] Robert Litan and Alice Rivlin, "Projecting the Economic Impact of the Internet", 91*Am.Econ. Rev*.313(2001).

[30] CNETAsia.2003. "Japan, China, and South Korea to Develop IPv6 in Asia. " <http: //asia. cnet. com/newstech/systems/ 0, 39001153, 39162960. htm>. as obtained on April 1, 2004.

[31] Nelson, R.R.1959. "The Simple Economics of Basic Research. "Journal of Political Economy67: 297-306.

[32] Litan, R.E., and A.M. Rivlin.2001. "Projecting the Economic Impact of the Internet. "American Economic Review 91(2): 313-317.

[33] Link, A.N., and J.T.Scott.2001. "Public/Private Partnerships: Stimulating Competition in a Dynamic Market. "International Journal of Industrial Organization 19: 763-794.

[34] Ladid, Latif.2001. "IPv6:The New Internet. " Presented at the International Telecommunications Union (ITU) Informal Forum Summit in Geneva, France, December 1-3.

[35] Kurose, James E., and Keith W. Rose.2001. Computer Networking: A Top-Down Approach Featuring the Internet.Boston: Addison Wesley.

[36] Jones, Dan.2002. "European IPv6 Plan Comes Under Fire. "<http: //www.unstrung. com/document. asp? doc_id=12812 &print=true>.

[37] IPv6 Style. March 28, 2003. "E!Agriculture Experiment in Gifu Prefecture. "<http: //www.i pv6style. jp/en/action/20030328/index.shtml>.

[38] Internet Society(ISOC). 2001. " IPv6 and the Future of the Internet. " http: //www. isoc. org/briefings/001.

[39] Internet Society Publications. January 2003. "Waiting for IP version 6. "<http: //ispcolumn. isoc. org/2003-01/Waiting. html>.

[40] IPv6 Promotion Council of Japan.February 29, 2004.http: //www. v6pc. jp/en/council/detail/index. html

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