A New Scheme for IPv6 BD-TTCS Translator: A Section Division Approach

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ABSTRACT
Divide and conquer(D&C) based IPv6 ALPM(Address Longest Prefix Matching) using a new reduced segment table(RST) is a challenging issue for an innovative and creative researchers due to increasing routing table size, the increasing link speed ,and the increasing network traffic with reduced packet size. In this paper we proposed a new innovative translator called BD-TTCS(Bi-Directional Transmission and Transfer Control System) which clearly illustrates reduction tree based on number of entries in a routing table using section division Method. We simulated and tested the proposed scheme using D&C based on IPv6 ALPM using a novel RST in BD-TTCS Translator. We used NS2 and Matlab 7.11.0(R2010b) to simulate results and in order to plot bar graph and Line Graph. To Judge the performance of our scheme on different performance parameters some results with different graphs are shown in the figures. From the perspective of analysis of computing time the overall time complexity of the proposed method is o(logn) where N is the number of routing entries in a routing table. Using NS2 based simulation results we have analyze the various performance parameters

Keywords
BD-TTCS;D&C;IPv4;IPv6;LPM;NS2(Network Simulator-2);RST etc.

1. INTRODUCTION
1.1.Divide and Conquer.

D&C is a novel data structure technique which briefly explains a mechanism like modularization idea of common general problem solving technique named top-down programming methodology. In D&C technique in order to achieve the solution directly, the problem component is broadly categorized into some smaller typical modules and these smaller typical modules are solved separately. In the later phases all these solutions are grouped together to create a solution for an original problem. Let us consider a function to calculate on n inputs the D&C technique suggests to split the inputs into k distinct subsets 1<k<=n, yielding k sub problems. These sub problems must be solved and a method must be indentified to combine solutions into a solution of the whole. When the sub-problems appears like a relatively large, then D&C idea is of same type as an original problem. This type of the reapplication of the D&C concept is naturally expressed by a recursive algorithm. The smaller and smaller similar sub problems are created until eventually sub problems that are small enough to be solved without splitting are produced. When we assume the D&C strategy it mainly splits the input into two groups of sub problems of the same kind as an original problem. The D&C technique is described by control abstraction.

Destination address prefix	Next-Node address	Output interface
76.40.32/40	224.47.177.167	3
45.87/16	189.47.177.171	2
112.12.16/20	192.41.177.148	4

Fig.1.IPv6 Forwarding Lookup table.

A forwarding table has been visited by a router utilises a destination address as a key and this mechanism is said to be address lookup. Once the forwarding information is retrieved, the v4-v6 enabled router can forward the packet from an incoming interface to the appropriate outgoing interface and this idea is also called a switching. The Figure-1 depicts the IPv6 forwarding table. Fast IP address lookup in a v4-v6 enabled routers which considers the packet destination address to determine for each packet the next node address is therefore crucial to achieve when packet forwarding rates are required.IP address lookup is very difficult to maintain because it needs LPM.

The exponential growth of network system has stressed its routing table hierarchy. While data rates of various links have kept face with the increasing traffic, it has been difficult for the packet processing capacity of routers to keep up with data rates. Specifically the IPv6 address lookup mechanism is a major drawback in the forwarding performance in the today's v4-v6 enabled routers in BD-TTCS translator. Since 1997,large number of LPM algorithms have been introduced,e.g[6-13].To store the routing entries into the memory it introduces the important concept like bitmap for the first time. The main idea of binary search on prefix length using hash tables, the complexity of hash tables, the complexity which is not relevant to the number of routing entries but it is only related to the number of distinct prefix length in a routing table. On the contrary it uses binary search on prefix intervals with the complexity of o(logN) where N is a number of routing entries.

Zhenqiang Li,Xiaohong Deng,Hongxiao Ma and Yan Ma described the usage of divide and conquer based scheme for IPv6 address longest prefix Matching. They have worked on divide and conquer based technique for 128 bits IPv6 longest prefix matching (LPM).This algorithm splits an IPv6 address into 8 chunks of 16 bits each and the chunks are reduced recursively through several tunable phases according to the tradeoff between lookup performance and memory consumption.

Miguel A.Ruiz-Sanchez,Ernst W.Biersack,Walid Dabbous presented a survey of state-of-the art IP address lookup algorithms and compare their performance in terms of lookup speed,scalability and update overhead.

Srisuresh and Egevang in the year 2001 described a popular solution to the shortage of IPv4 addresses in Network Address Translation(NAT) which consists of hiding networks with private IPv4 addresses behind a NAT-enabled router with few public IPv4 addresses.

In their work Zeadally and Raicu in the year 2003 proposed the IPv6/IPv4 performance on Windows 2000 and Solaris 8.In their work they connected two identical personal computer's using a point-to-point connection. In order to calculate various performance issues namely Throughput, Round-trip time, CPU utilization, Socket-creation time and client–server interactions for both TCP and UDP. They used packets ranging from 64 to 1408 bytes. Their experimental results explain that IPv6 for Solaris 8 outperform IPv6 for Windows 2000, while IPv4 outperform IPv6 for TCP and UDP.

Zeadally et al.(2004) designed and calculated IPv6/IPv4 performance on Windows 2000,Solaris 8,and RedHat 7.3.The authors experimentally measured throughput of TCP and UDP ,latency, CPU utilization, and web-based performance characteristics. Mohamed et al.(2006) evaluated IPv6/IPv4 performance on Windows 2003,FreeBSD 4.9 and Red Hat 9.They measured throughput, round-trip time, socket-creation time,TCP-connection time and number of connections per second in three different test-beds.The first test-bed consists of a single computer and communication was limited to processes running in this computer using the loopback interface. In the second test-bed, two computers were connected through an Ethernet hub. The Ethernet hub was replaced by a router in the third test-bed. They used packets ranging from 1 byte up to the limits of an IP packet (which is typically around 65,535 bytes).

Another solution to the shortage of IPv4 public addresses that faces the Internet consists to migrate to the new version of the Internet protocol(Davies,2002;Deering and Hinden,1998;Popoviciu et al.,2006),called IPv6,or the coexistence between both protocols(Blanchet,2006).IPv6 fixes the number of problems in IPv4,such as the limited number of available IPv4 addresses.IPv6 has a 128-bit address, while IPv4 has a 32-bit address.

Shiau et al.(2006) evaluated IPv6/IPv4 performance in two different scenarios. In the first scenario, they connected two identical computers using a point-to-point connection. In the second scenario, the two identical computers were each connected to a real large-scale network environment through a Cisco 3750GB switch and a Cisco 7609 router. Fedora Core II was the operating system of the two computers. The authors reported results such as throughput, round-trip time, packet loss rate, for both TCP and UDP. None of these previous works compares the experimental results for both TCP and UDP throughput to the maximum possible throughput.

The paper is organized into 4 sections.Sections-2 clearly explains the proposed methodology to split 128 bits IPv6 address using Section division approach. The simulation results are reported in section-4.Finally the conclusion is given in section 5.

2. PROPOSED METHODOLOGY

2.1.Classification of Packets based on section criterion.

In this packet classification method we have adopted a recursive flow classification method(RFC) in Fig.2.By applying several phases instead of one step in cross product introduced by Venkatachary in [4],RFC reduces the memory requirement significantly. The distinct filter sets, called equivalence classes, are used to reduce the size of the adjacent phases. The index to successive phase is created by combining the equivalence class IDs obtained from the slices in the previous phases

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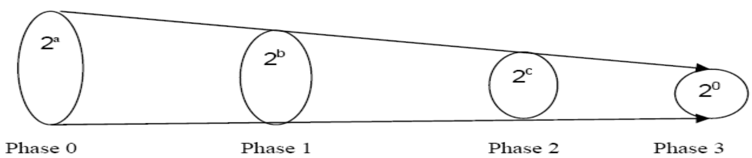

Fig.2.Recursive Flow Classification.

In this paper we have applied one of the technique like D&C method to IPv6 LPM. In this IPv6 LPM technique IPv6 address is broadly splitted into 8 sections of 16 bit long portions as shown in figure.3.We can view a portion of IPv6 netid in the routing table as a field of the filter in the filter set and the output interface of the route entry

.

Slice-1	Slice-2	Slice-3	Slice-4	Slice-5	Slice-6	Slice-7	Slice-8

Fig.3.The 8 slices of an IPv6 address.

2.2.RST based on D&C in BD-TTCS Translator.

The proposed flowchart like RST is depicted in Fig.4.The hierarchy of this flowchart is called reduction tree ,is created on the number of entries in a routing table using slice division, a route entry is separated into 8 slices, which can be treated as the fields of the filter in the filter set. The output port of the route entry is viewed as a action field of the filter .Hence the IPv6 LPM problem is converted into 8 dimensional packet classification problem.The reduction tree of the algorithm has several tunable levels and we can see some segment tables preprocessed based on the routing table

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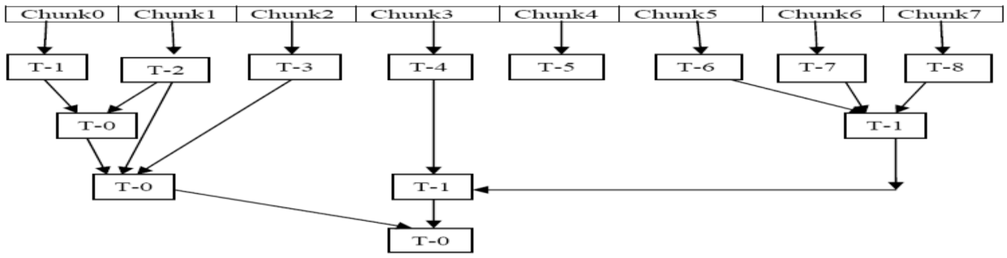

Fig.4.RST using Slice wise D&C technique.

3. SLICE WISE DIVISION ALGORITHM FOR IPV6 BD-TTCS TRANSLATOR USING D&C METHOD.

To design the RST of level-0 the prefixes of the IPv6 Source and Destination addresses are splitted into eight 16-bit-long sections each. One of the most important problem is that the lengths of the netid's in the IPv6 source and Destination addresses are less than 128 bits. So the remaining bits are to be padded with 'do not care' which can be specified by prefix interval with a begin and a stop point. The flow chart for slice separation is depicted below.

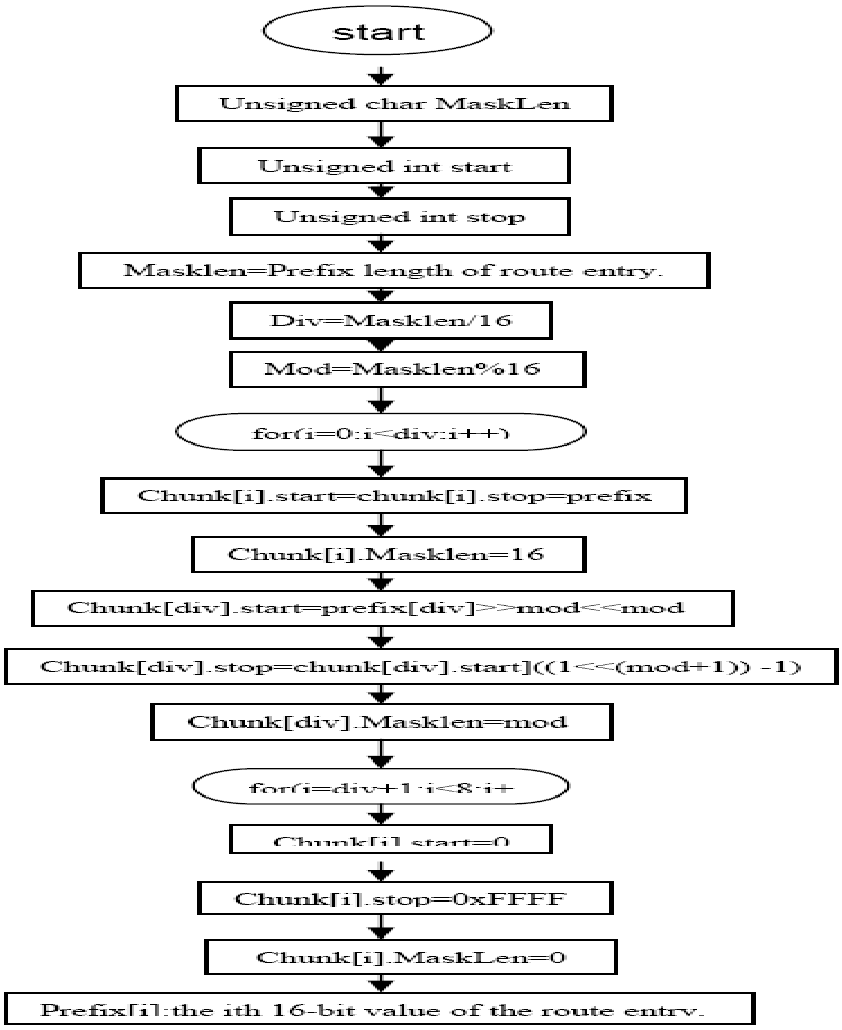

Fig.5.The Basic Flowchart of D&C based Slice Division in BD-TTCS Translator.

The basic flowchart shows the D&C based slice wise division in BD-TTCS translator. The RST implemented in this way is called B RST(Basic reduced segment table).RST are also implemented in software. The preprocessing time and memory consumption of RST are in inverse proportion with the number of levels in the reduction tree and can be tuned by adjusting the shape of the reduction tree with a given number of levels. The lookup complexity of BRST is 0(1).Its performance is mainly dominated by the number of phases in the reduction tree and has nothing to do with the number of the entries and distribution of the entries in a routing table.

4. SIMULATION SCENARIO.

For the Performance study of D&C based IPv6 ALPM in BD-TTCS Translator a basic scenario is necessary to analyze various aspects separately. The studied scenarios(See Fig.6.) consists of a collection of an IPv4 network and an IPv6 network,DNS46,DNS64,DHCPv6 protocol,v4-v6 enabled router. We have connected IPv4 network and IPv6 network to central v4-v6 enabled router(CER).through the 'Internet'. Node N1 and Node N2 are also connected to the central v4-v6 enabled router and we have also connected the DNS46,DNS64 with DHCPv4 and DHCPv6 protocols in the initial set up .

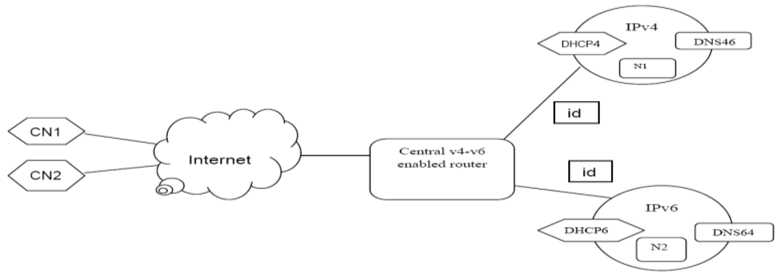

Fig.6.BD-TTCS Translator in an IPv6 Network.

4.1.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 [1].It's essentially a discrete event simulator[5][6][7].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[7].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 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 software to implement network simulation in the academic field[5][6].

Event Scheduler	***NS2***
Tclcl	Network component
Otcl	
Tcl/Tk	

Fig.7.The main components of NS2**.**

4.2.The basic components in NS2

ns is an object oriented simulator, written in C++,with an OTcl interpreter as a frontend.*ns* uses two languages because simulator has two different kinds of things it needs to do. On one hand, detailed simulations of protocols requires a systems programming language which can efficiently manipulate bytes, packet headers, and implement algorithms that run over large data sets. For these tasks run-time speed is important and turn-around time (run simulation, find bug,fix bug,recompile,re-run) is less important. 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.*ns* meets both of these needs with two languages,C++ and OTcl.C++ is fast to run but slower to change, making it suitable for detailed protocol implementation. OTcl runs much slower but can be changed very quickly(and interactively), making it ideal for simulation configuration .In NS-2,the frontend of the program is written in TCL(Tool Command Language). The backend of NS-2 simulator is written in C++ and when the tcl program is compiled,a tracefile and namfile are created which define the movement pattern of the nodes and keeps track of the number of packets sent,number of hops between 2 nodes, connection type etc at each instance of time.With our *ns-2* simulations we study the impact of several system parameters over the performance metrics for the scenario described in Section 2.We analyze the degradation of the performance metrics from the point of view of a single mobile node that follows a deterministic path while all other mobile nodes in the system follow the random waypoint mobility (RWP) model[43].The RWP model is well-suited to specify the motion of mobile users in campus or hot spot scenarios at moderate complexity[43].

5. PERFORMANCE ANALYSIS, SIMULATED RESULTS AND DISCUSSIONS

We analyze the performance analysis of D&C based IPv6 ALPM in BD-TTCS Translator with respect to packet loss, round trip time, delay(latency) etc. These parameters are explained in more detail below. Furthermore, we investigate how a BD-TTCS translator improves the above mentioned measurements. We have implemented a BD-TTCS Stateless translator in NS2 environment. We use stateless address auto configuration to implement BD-TTCS translator. In the following we define the parameters investigated in the Simulations.

Throughput:Ratio of the packets delivered to the total number of packets sent.

1.**Packet Delivery:**Packet Delivery Ratio in this simulation is defined as the ratio between the number of packets sent by constant bit sources(CBR) and numbers of packets received by CBR sink at destination.

Packet_Delivery%=$\sum_1^n CBR\ Sent / \sum_1^n CBR\ Received$ X100 ------------(1)

Minimum Delay: Minimum Time taken for the packets to reach the next node.

Maximum Delay: Maximum Time taken for the packets to reach the next node.

Average End-to-End Delay: Time taken for the packets to reach the destination

Avg_End_to_End_Delay=$\sum_1^n CBR\ SentTime - CBR\ receivedTime / 1nCBR\ Received$------------(2)

Simulation Time:The time for which simulations will be run i.e. time between the starting of simulation and when the simulation ends.

Network size:It determines the number of nodes and size of area that nodes are moving within. Network, size basically determines the connectivity. Very lesser nodes in the same area mean fewer neighbours to send request to, but also smaller probability of collision.

Number of Nodes: This is constant during the simulation. We used 50 nodes for simulations.

Pause time: Node will stop a "pause time" amount before moving to another destination point.

Jitter :Jitter describes standard deviation of packet delay between all nodes.

Jitter(J) = $|D_{i+1} - D_i|$ ----------------(3)

Power Consumption: The total consumed energy divided by the number of delivered packet.

Average Packet Delay:It is the sum of the times taken by the successful data packets to travel from their sources to destination divided by the total number of successful packet. The average packet delay is measured in seconds.

End-to-End (D)=$T_d - T_s$ ---------------- (4)

Where T_d = Packet time received at destination node and T_s= Packet sent time at Source node.

Average Hop Count: It is sum of the times taken by the successful data packets to travel from their sources to destination divided by the total number of successful packets. The average hop count is measured in number of hops.

Node Expiration time (NET): It is the time for which a node has been alive before it must halt transmission due to battery reduction. The node expiration is plotted as number of nodes alive at a given time, for different point in time during the simulation.

Packet loss: Packet loss is one which is defined as the network traffic fails to reach its destination in a timely manner. Most commonly the packet gets dropped before the destination can be reached.

Packet dropped/loss (P_d) =$P_s - P_r$ --------------(5)

Where P_s is the amount of packet sent at Source and P_r is the amount of packets received at Destination, Where D_{i+1} are delay of i^{th}+1 packet and D_i is the delay of i^{th} communication packet.

The following table (Table-4)shows the simulation parameters, which are used to calculate the performance measurements using ns-2 simulation environment when each packet arrival follows a Poisson process with rate λ=2

Sl. No	**Parameter**	**Value**
1	*Simulator*	Ns-2
2	Simulation time	500 s
3	Simulation area	700X700
4	Transmission range	450 m
5	Bandwidth	3Mbps

6	Traffic type	CBR
7	Data payload	Bytes/packet

Fig.8.Parameters of Simulation.

5.1. Simulation Results

Fig.9.shows the part of our simulation result over the simulation time 0 to 60 seconds for the Packet delivery Fraction ratio versus Pause time when the size of the packet varies from 0 to 65536 for 50 nodes with 10 Sources.

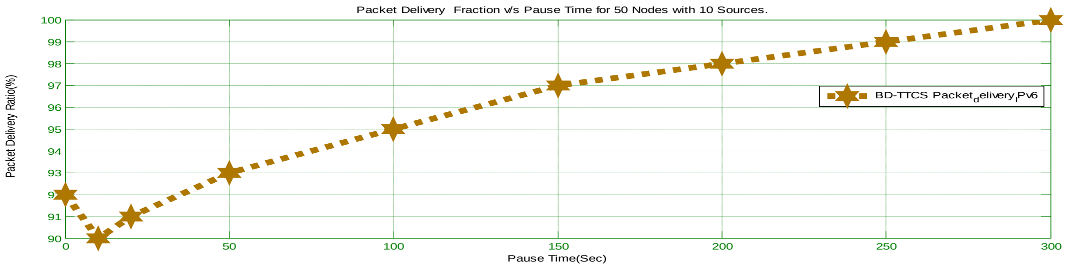

Fig.9.Packet delivery Fraction ratio versus Pause time for 50 nodes with 10 Sources

Fig.10.shows the part of our simulation result over the simulation time 0 to 60 seconds for the end to end delay versus Pause time when the size of the packet varies from 0 to 65536 for 50 nodes with 10 Sources
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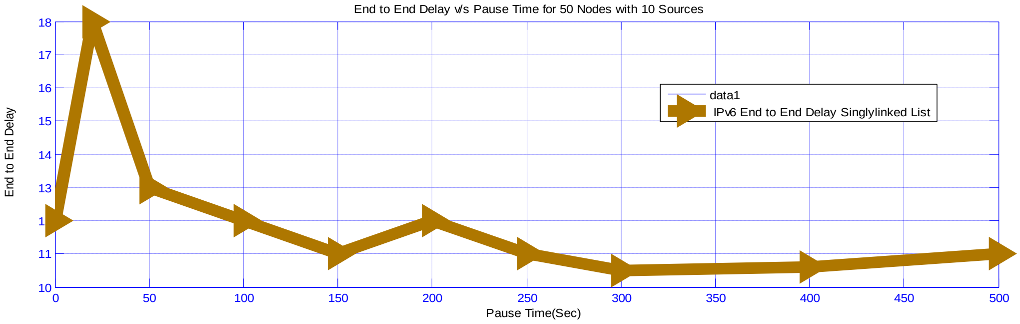

Fig.10.End to End delay versus Pause time for 50 nodes with 10 Sources

5.2.Analysis of Graph of Throughput versus number of nodes Fig.11. and Fig.12. shows the part of our simulation result which shows Packet delivery Fraction ratio versus Pause time for 50 nodes with 10 Sources and end to end delay versus Pause time for 50 nodes with 10 Sources

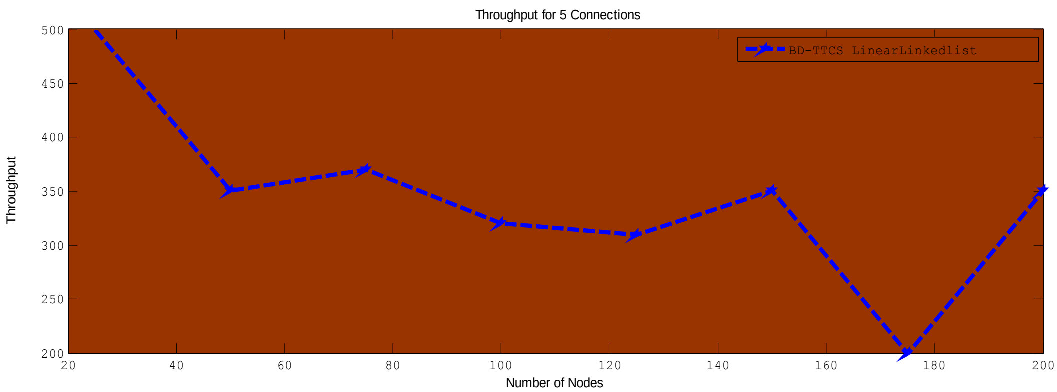

Fig.11.Graph for Number of Nodes v/s Throughput for 5 Connections in IPv6.

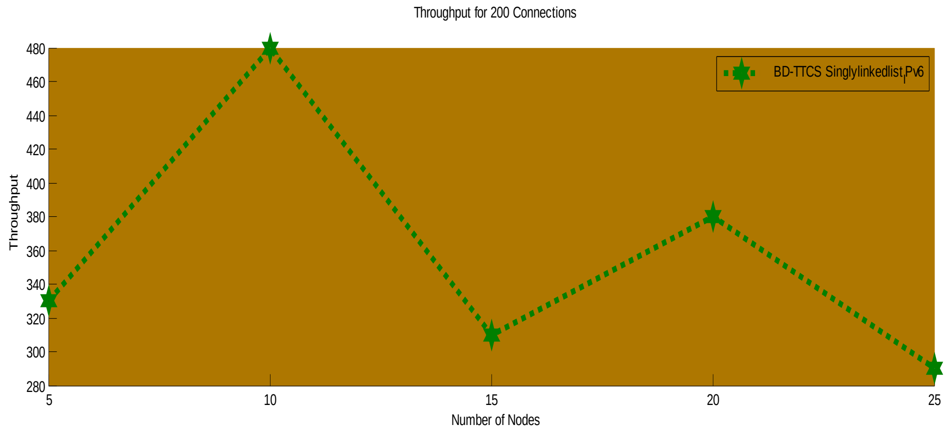

Fig.12.Graph for Number of Nodes v/s Throughput for 200 Connections in IPv6.

6. CONCLUSION AND FUTURE WORK.

In this paper we have concluded the various performance issues of D&C based IPv6 ALPM in BD-TTCS Translator with respect to packet loss, round trip time, delay (latency) etc. We performed a simulative evaluation of a performance analysis of D&C based IPv6 ALPM using a novel RST algorithm in ns-2 for a scenario comprising up to 4 levels from level-0 to level-4 and it has 8 slices from slice0 to slice7.We also implemented and simulated a complex data structure concept like D&C based IPv6 ALPM using a novel RST algorithm in BD-TTCS Translator. It is also possible to prove the D&C based IPv6 ALPM using a novel RST is an innovative, challenging and qualitative research problem for future innovative researchers. The future work will focus on IPv4/IPv6 transition algorithm Implementation and Performance issues with singly linked list in NS2 Simulator.

7. ACKNOWLEDGEMENT

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9. AUTHORS PROFILE

Ramesh K. was born in 1975.He received his **BE Degree in Computer Science and Engg** from Bangalore University,Bangalore,Karnataka,India in 1998,his M.Tech(CS&E) from B.V.B College of Engineering Technology,Hubli,Karnataka,India in 2005. He is also an **Asst.Professor** at the Department of Studies in Computer Science,Karnatak University Dharwad.and presently pursuing Ph.D in **Computer Science** under the supervision of Dr.H.B.Walikar on an area of Interconnection Networks and on the topic entitled "**Survivable Networks and Multi-Layer Failure Recovery"** at Dept of Computer Science,Karnatak University Dharwad,India.Prior to his current position Mr.Ramesh K spent 7 years of service in various reputed engg institutions.

Hanumanthappa.J. was born in 1975.He received his **BE Degree in Computer Science and Engg** from Kuvempu University,Shankar ghatta,Shimoga,Karnataka,India in 1998,his M.Tech(CS&E) from National Institute of Technology,Surathkal,Karnataka,India in 2003. He is also an **Asst.Professor** at the Department of Studies in Computer Science,University of Mysore,Manasagangothri,Mysore-06.and presently pursuing Ph.D in **Computer Science** under the supervision of Dr.Manjaiah.D.H on an area of Wired Networks and on the topic entitled "**Investigations into the Design,Performance and Evaluation of a Novel IPv4/IPv6 Transition Scenarios"** at Dept of Computer Science,Mangalagangothri,Mangalore,India.Prior to his current position Mr.Hanumanthappa.J spent 3 years of service in various reputed engg institutions like U.B.D.T.C.E,S.V.I.T,Y.D.I.T,SIR.M.V.I.T,and one Polytechnic like STJ,Harapanahalli.He is an active researcher and an eminent teacher in the areas pertaining to Protocol Performance issues,Wireless IP Networking,Wired Networking,Multicast routing protocols for Mobile IP nodes,and streaming multimedia communication in Wireless networks,Computer Networks,Ad-hoc Networks,Mobile

Adhoc Networks,Sensor Networks etc having made an excellent contribution towards Teaching and Research for nearly 11 years.He is a life member of Institution of Engineer's(IEI) and Indian unit of Indian Society for Technical Education(ISTE).He has been serving as an Associate Editor,Guest editor,co-editor,Session chair in International/National Conferences and Programme committee member and Reviewer in many International refereed Journals and conferences.He has supervised large number of students at M.Sc,MCA, and M.Tech level.He has over 45 publications in journals and conferences of International repute.He has chaired several sessions in international conferences.He is a visiting professor to Huang Huai University, Zhumadian, China. Thus Mr.**Hanumanthappa.J** in his long, active and innovative academic career has not only dedicated and contributed significantly to the area of Protocol Performance issues but has,in fact,been instrumental in launching a crusade for introduction of value education and promotion of holistic approach in the Indian technical education system.He also has a unique distinction of carrying out innovative work towards the Integration of Science,Technology and Human values and introducing a holistic approach to technical education as well as Technology development.

MANJAIAH D.H. is currently Professor and Chairman of the Dept.of Computer Science.,Mangalore University,and Mangalore.He is also the BoE and BoS Member of all Universities of Karnataka and other reputed universities in India.He received **PhD degree** from University of Mangalore,**M.Tech.from NITK,Surathkal** and **B.E.from Mysore University.**Dr.Manjaiah D.H has more than 15-years extensive academic,Industry and Research experience.He has worked at many technical bodies like **CSI[AM IND 00002429],ISTE[LM-24985],ACS,IAENG,WASET,IACSIT and ISOC**.

He has authored more than-50 research papers in International / National reputed journals and conferences. He is the recipient of the several talks for his area of interest in many public occasions.He had written Kannada text book,with an entitled,**"COMPUTER PARICHAYA**",for the benefits of all teaching and Students Community of Karnataka.Dr.Manjaiah D.H 's areas interest are **Advanced Computer Networking,Mobile/Wireless Communication,Wireless Sensor Networks,Operations Research,E-commerce,Internet Technology** and **Web Programming**.He is the expert committee member of various technical bodies like **AICTE**,various **technical Institutions** and **Universities** in INDIA.He had been actively involving in chairing technical sessions of various International & National Conference and reviewer of the Journals.

He is working with Major Research project on "**Design Tool for IPv6 Mobility for 4G–Networks**",around **Rs.12 lakhs worth funded by UGC,New Delhi from year 2009-20 12**.He is recognized as a Ph.D.guide in Computer Science at Mangalore University,Mangalore and currently five students are doing their Ph.D.,under the guidance of him.He is recognized as advisory editorial board member of the International Journal of Advanced Computing [IJAC],International Journal of Computer Science and Application [IJCSA],and Journal of Intelligent System Research and Journal of Computing.He visited most of the countries in the actively involving in chairing technical sessions of various International & National Conference and reviewer of the Journals.

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