Alternate Multi Path Routing Architecture for ATM Networks

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Abstract: **The requirement of bulk data transmission is increasing with the rapid growth in computing and networking. To satisfy the growth an advanced high speed network is required. The major points to be worked for maintaining of high speed are route selection and route utilization . The mechanism of routing may provide the optimal route in hierarchical network environment from the perception of maximizing of network environment by the usage of maximum resources. In this paper, an Alternate multipath routing mechanism and the architecture to search the multiple paths from the source to destination is given.**

Keywords: **Routing algorithm, High-speed networks, Hierarchical, ATM, ISDN, Competitive Routing and Multipath Routing.**

I. INTRODUCTION

Many advancements has been made in recent years in computing and networking technology. At the network level, different new high-speed technologies such as Integrated Service Digital Network (ISDN), Digital Subscriber Line (DSL) and Fiber Distributed Data Interface (FDDI), Asynchronous Transfer Mode (ATM), networks are highly deployed in research institutions and industry [7]. These networks have the capability of transmitting information at high speed, and also have the potential to offer a wide range of Quality of Service (QoS) properties including boundations on delay, guarantees on throughput and isochronous communications. The accelerating demand for remote data access, web services, computing capabilities regardless of user location and mobility require a communication infrastructure with a higher. In general, broadband refers to telecommunication in which a wide range of frequencies are available to transmit information. Because a wide band of frequencies is available, information can be multiplexed and routed on many different frequencies or channels within the band concurrently, allowing more information to be transmitted in a given amount of time

- Newton's Telecom Dictionary: "...greater than a voice grade line of 3 KHz...some say [it should be at least] 20 KHz."
- Jupiter Communications: at least 256 Kbps.
- IBM Dictionary of Computing: A broadband channel is "6 MHz wide [20].. Some of the networks that are available for providing these types of services are Asynchronous Transfer Mode (ATM), frame relay, and leased lines.

As Broadband Integrated Services Digital Networks (B-ISDN) standards and modern networks are expected to provide a wide range of services [2]. Routing is the process of selecting paths in a network to send network traffic. Routing is performed for many kind of networks including the telephone network (Circuit switching), electronic data networks (as Internet), and transportation networks. Path selection in network routing has typically been formulated for shortest path problem. The problem of routing in a dynamic environment due to fluctuations in traffic load, link failures and topology changes [1]. Hierarchical network deployment is one of the popular approaches for providing network scalability, such as PNNI [ATM96b] and OSPF [MOY94]. These are based on network topology abstraction and decomposition of large-scale networks from the perspective of the management domain [3].

Multipath routing schemes used to distribute traffic among multiple paths instead of routing all the traffic along a single path. Two key queries that arise in multipath routing are *how many paths are required* and the *selection of these paths.* Multipath routing has been used in all kinds of existing communication networks like the Internet, ATM networks and high speed networks based on the QoS requirements [14]. In the single-path routing infrastructure, only one path exists between two networks in the internetwork. While it may simplify the routing tables and the packet flow paths, single-path internetworks are very less fault tolerant. A fault can be sensed by a dynamic router, but the networks across the failure are unreachable in the fault duration. A downed link or a downed router must be brought back before packets can be delivered successfully across the downed link or router [21].

In a multipath routing infrastructure, multiple paths exist between networks in the internetwork. Multipath internetworks are fault tolerant when dynamic routing is used, and some routing protocols, such as OSPF, can balance the load of network traffic across multiple paths with the same metric value. Multipath internetworks, are more complex to configure and have a higher probability of routing loops during convergence when using any distance vector–based routing protocols [24].

Adaptive routing algorithms in contrast change their routing decisions to reflect changes in the topology, and mostly the traffic and Adaptive algorithm differs in where they get their information (e.g. locally from adjacent routers, or from all other routers), when they alters the routes, and what technique is used for optimization (e.g. distance, number of hops, or estimated transit time). It consist low routing overhead. The iterative routing, the source try to find a sequence of nodes to which other intermediate nodes have to just iterate or multi-pass thoroughly until the destination is reached.

At the network level, the route selection and resource reservation are the major issues in high speed network due to fluctuations in traffic load, link failures and topology changes[17]. The routing mechanism may provide the optimal route in the hierarchical network environment from the perspectives of maximization of network resource utilization.

II. BACKGROUNDS

For the multi-constrained routing problem a heuristic algorithm[4], which involves two or more additive weight functions, has been proposed. In the case of delay-cost routing, the algorithm first maps the costs to bounded integers and then uses an extended Dijkstra's algorithm to find a solution for the new problem. A feasible path of the new problem is shown to be also a feasible path of the original problem.

For services with delay guarantees [5-6] showed that when a broad class of WFQ-like scheduling algorithms are used, the bandwidth, delay, jitter and/or buffer space bounds are not independent. Finding a path that satisfies delay, jitter, and buffer space constraints is solvable in polynomial time only if the relationship between bandwidth, delay and jitter is taken into consideration.

A framework for online throughput competitive routing [17-8] has been proposed. This algorithm combines routing and admission control into a single strategy. It assigns each link a length which is an exponential function of the current bandwidth utilization on the link. If no sufficiently short path exists, the request will be rejected. A *competitive ratio* is defined to compare the performance achieved by the online routing algorithm over the performance achieved by the optimum offline routing algorithm with all the input sequences, and the performance of the algorithm is measured in terms of a bandwidth-duration product, i.e. the throughput.

The Wang-Crowcroft algorithm [9-10] finds a path for any given constraint on bottleneck bandwidth and propagation delay. First, any link with a bandwidth less than the requirement is eliminated so that any path in the resulting network topology graph satisfies the bandwidth constraint. Then the path with minimum length is computed using Dijkstra's algorithm to determine whether a feasible path exists. A two distributed algorithms for hop-by-hop routing is also proposed

A call-by-call source routing strategy[11] that makes use of rule based fallbacks. This strategy provides a flexible platform on which routing can be done efficiently subject to performance, resource and priority constraints. The fallback routing algorithm sequentially computes paths based on a predetermined fallback sequence of routing instances, until an acceptable one is available or the call will be blocked. The proposed routing architecture uses hierarchical source routing with optional crankbacks. A variety of traffic-dependent QoS-related topology state parameters are advertised to support call-level QoS matching. Topology information at each hierarchical level is aggregated to trade-off fine-grain QoS matching for scalability in very large networks.

A new QoS routing algorithm[12] for ATM networks which is compliant with the PNNI protocol has been proposed. The algorithm tries to find a path iteratively with different sets of path search approaches until the obtained path meets the requested QoS. The procedure is as follows: First, a candidate path that satisfies the QoS requirements is found. The algorithm then prunes all links that cannot guarantee the requested bandwidth from the whole known topology information, by calculating the equivalent bandwidth of the requested call and comparing it with the bandwidth available for each link. From this reduced set, one or more possible paths are chosen.

The distributed algorithms for the secure multipath routing[23] has been explained. In this routing, data sent on the multipath so that intruders require much more resources to mount successful attacks. The paper includes (1) distributed routing decisions (2) bandwidth- constraint adaptation (3) lexicographic protection. In the paper two algorithms are used

for the solution (1) Bound control algorithm (2) Lex control algorithm and prove their convergence to the respective optimal solution. The basic of paper is to design a distributed solution, which implement the selecting data across the multipath on the architecture.

PROPOSED ARCHITECTURE

The proposed architecture provides optimal routing service in a hierarchical based high speed network with routing scheme. This architecture is comprised of *three* components: 1. Network Topology and route info. Manager(Nw*Mgr*), 2. Fault Manager (*FaultMgr*) and 3.Route Manager(*RouteMgr).* The Nw*Mgr first,* assigns the node address and link state attributes and metric parameters, then the *node initiator* assemble all the state information into an ‗Initiate‘ packet and send to its neighbour nodes. In the *DB Sync*. Process, nodes updates its topology database with HTSE (*Hierarchal Topology State Element)*.

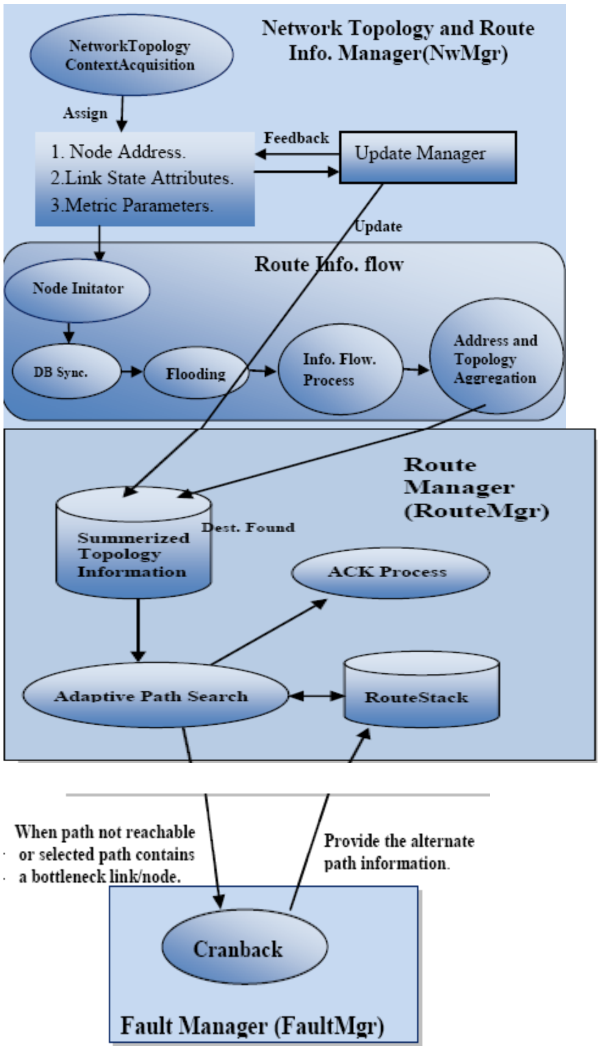
In the *flooding* process, A node in the peer group proceeds to propagate the topology information to all members of the group. Receiving node send the acknowledgement to the receipt, then all the nodes update its topology database.

In the Info. Flow Process, the Group Leader summarizes the topology info. of all nodes of its peer group and propagates the info. to its upper level Group. Address summarization, to represent a collection of end systems by the single reachable address prefix, is performed.

Topology aggregation process of reducing topology information by summarizing nodal as well as link information, is performed. All the summerized topology information is passed to the RouteMgr.

The RouteMgr perform the adaptive path search algorithm and maintain the searched path in RouteStack and provide the acknowledgement when the destination node is found.

The *FaultMgr* perform the crankback process, when the path not reachable or the selected path contains a bottleneck node/link. It provides the alternate path to the route manager for the same destination node.



Proposed Mechanism

Phase - I: Network Topology, Context and state Acquisition

Step – 1: Network Topology and State Parameters

NetworkTopologyContextAcquisition( )

{

 AssignNode's _address( )

{

Assign a unique address dynamically using the DHCP server.

}

 FindNetworkTopology_State( )

{

//*Link State Attribute parameters are* Available Cell Rate (ACR), Max. Cell Rate(MaxCR),

Cell Rate Margin(CRM), Variance Factor(VF).

 Assign the values to the link state attributes.

// *Metric Parameters* such as cell transfer delay (CTD), jitter or Cell Delay Variation (CDV) and cell loss ratio (CLR), Administrative weight(AW)

 Assign the values to the Link State Metric parameters.

}

Step – 2:

RouteInfoflow_Computation ( )

{

If (Node is Active)

{

Node_Initialization( );

Database_Synchronization ( );

Flooding( );

Info_Flows ()

AddressSummarizations_Topology Aggregation();

}

}

Node_Initialization ( )

{

 Packet Initialization Data(PID) assemble all the state information into an _Initiate' packet(End-system address, Node ID, Hierarchal Group ID[HGID]).

 Send_Initiate' packet to its immediate neighbours.

 Neighbour compare the received HGID with its own HGID.

 If both match, node tries to synchronize its topology database.

}

Database_Synchronization ( )

{

 HTSE Header (HTSE ID, sequence number, checksum, remaining lifetime) is created .

 Nodes Exchange the *Hierarchal Topology State Element* (HTSE) header information.

 Node requests for the advertised HTSE.

 Node updates its topology database with received HTSE.

}

Flooding()

{

 A node in the peer group proceeds to propagate the topology information to all members of the group.

 HTSEs are bundled within a *Hierarchal Topology State Packet* (HTSP) and transmitted to all the neighbouring nodes.

 Receiving node send the acknowledgement to the receipt.

 Node update its topology database.

}

Info_flows()

{

 Group Leader summarizes the topology info. of all nodes of its peer group e.g GL(X.Y)

 Group leader propagates the info. to its upper level Group e.g. GL(X).

 Other side, a GL receives downward info. of the same higher-level group.

 The GL then propagate the received info. to all members of the group.

}

AddressSummarizations_Topology Aggregation()

{

 Address summarization, a process of the single reachable address prefix to represent a collection of end systems, is performed.

 Process of reducing topology information by summarizing nodal as well as link information, is performed.
 Helps in hiding the internals of a group as well as reduce the flow of control in the network.
 Makes maintenance of topology information easier.
}

Phase II: Route Selection Process
AdaptivePathSearch()

{
//Every route maintain the following information. Bandwidth(BW) of route, Cell Delay Variation(CDV),
Cell Transfer Delay(CTD), that‘s composed into the a packet.

BW	CDV	CTD	Rehability Info

Figure 2: Route packet format

Source initiates the request to its nearest neighbour node using the following packet-

SOURCE ID	DEST ID	DESTGRP LVL	HOP CTR	TIMESTAMP	PATHDETAILS

Figure 3: Source Route Request Packet Format

After receiving the request, Every node creates a stack of list for hierarchy route information that contains the upper level hierarchy information.

Repeat

//Check If Destination Group Level is equal to Current Group Level.

If(DestGrpLvl = = CurrGrpLvl)

{

//Compare the value of Destination ID of the current request with the Current Node ID .

If (DestID== CurrNodeID)

Return a route reply packet to the source along the selected route details.

else

Forward the request to the next adjacent node of the current group.

//Increment the value of the hop count with every reachable node.

HopCtr=HopCtr+1;

//Check whether the Current Node has multiple paths.

if((HopCtr)CurrNodeID >1)

{

 Current Node request to the Group Leader(GL) to check the Bandwidth(BW) of each route.

//Check whether the Bandwidth of two route i.e. Ri and Rj are same.

if ((Ri)BW == (Rj)BW)

Assign the higher priority to the route that have *Min. CTD* and *CDV* value.

else

 Group leader(GL) give the priority to the highest BW route and pick the route upto the destination address with highest BW .

 Group leader(GL) provide the appropriate path to current Node upto the destination address.

 Current Node append this path information to their stack as a new list .

 Current Node transfers the request to the nearest neighbour node.

}

//Check whether the Destination Group Level is not equal to Current Group Level.

else if (DestGrpLvl != CurrGrpLvl)

{

 Node looks for the appropriate path in its topology information and finds a appropriate path to the last node of the current peer group.

 Push this path information in top of the stack of the node as a new list.

 Forwards the connection request to next node in the same peer group.

 Next node does not perform any search bcz route has been determined by the previous node, just forward the request to next node.

 Last node look and find in the list of the stack ,to which peer group the request has to be transferred now.

 Last node using its topology information finds a link to reach the nearest node of next peer group.

Check whether the requested path is not reachable OR selected path contains a bottleneck link/node

Perform Crankback process.

Until destination address are not reached.

Phase-III: Route ACK Process

//Perform when Destination node address found and it send the route reply packet to source node.

 When any node receives a route reply packet.

 It check, whether the current node is the source node.

 Records the path to destination along with its time of arrival from locally maintained time.

 Otherwise, if it is an intermediate node, it appends the value of affinity and propagates the packet to the next node listed in the route record to reach the source node.

Phase-IV. Data Transmission Mechanism

Initialize sets {***Di***}=null and {***Pi***}=null

Repeat For all Data(D)

 Call **AdaptivePathSearch** algorithm that gives a set of stable paths with route-discovery-time and number of hop counts for those paths.

 The paths pj (j=1,2,…) are selected for the set **Pi.**

 Data‘s are divided for the set of stable paths and transfers on it.

Until all the data has not been transferred.

CONCLUSION

The proposed multipath routing architecture and mechanism for High speed networks is effective and efficient and it takes advantage of the PNNI hierarchical structure to reduce path computation complexity and maximize network throughput. It would works in very effective and efficient manner over the high speed network. But the heterogeneous nature of node, someone affects it‘s effectiveness particularly when network scalability feature is very high, although, at low scalability it would be very efficient. As in the era of communication particularly, when communicating nodes changes their locations then it‘s efficiency is get reduced.

REFRENCES

[1]. Chen-Khong Tham, Jianning Mai & Lawrence WC Wong, ―*A QoS-Based Routing Algorithm for PNNI ATM Networks"*, Elsevier , Computer Communications, 2002, Volume 25, Issue-7, pp: 714-729

[2]. Li Layuan Li Chunling, ―*The QoS-Based Routing Algorithms for High-speed Networks"*, IEEE, 2000, ISBN: 0-7803- 6394-9, pp.1623-1629.

[3]. Daniel Won-Kyu Hong and Choong Seon Hong, ―*Bounded Flooding Routing Algorithm for Provisioning the Globally Optimal Route in a Hierarchical ATM Network"*, Journal of Universal Computer Science, vol. 8, no. 7 (2002), pp. 698-721.

[4] S. Chen and K. Nahrstedt, "*On Finding Multi-Constrained Paths"*, IEEE ICC'98, June 1998

[5] Q. Ma and P. Steenkiste, "*Quality of Service Routing for Traffic with Performance Guarantees"*, IFIP International Workshop on Quality of Service, New York, May 1997

[6] Q. Ma and P. Steenkiste, "*Routing Traffic with Quality-of-Service Guarantees in Integrated Services Networks"*, 8th International Workshop on Network and Operating Systems Support for Digital Audio and Video (NOSSDAV'98), England, IEEE/ACM, July 1998

[7]. Ojesanmi O.A , ―*Asynchronous Transfer Mode (ATM) Network*‖, International Journal of Advanced Computer Engineering, *ISSN: 0974-5785,* (Vol.3 No.1 Jan-June 2010), pp: 41-49.

[8] B. Awerbuch et. al., *Throughput-Competitive On-line Routing*, 34th Annual Symp. Foundations of Computer Science, Palo Alto, CA, November 1993

[9] Z. Wang, J. Crowcroft, *Bandwidth-Delay Based Routing Algorithms*, IEEE GLOBECOM'95, Singapore, Nov 1995

[10] Z. Wang, J. Crowcroft, *QoS Routing for Supporting Resource Reservation*, IEEE Journal on Selected Areas of Communications, Vol.14, No.7, pp.1228-1234, Sept 1996

[11] W. Lee, et. al., *Routing Subject to Quality of Service Constraints in Integrated Communication Networks*, IEEE Network Magazine, Vol.9, No.4, pp.46-55, July/August 1995

[12] Atsushi Iwata et. al., *ATM Routing Algorithms with Multiple QoS Requirements for Multimedia Internetworking*, IEICE Trans. Comm. Vol. E79-B, No.8, pp.999-1007, August 1996

[13] S. Plotkin, *Competitive Routing of Virtual Circuits in ATM Networks*, IEEE Journal on Selected Areas of Communications, vol.13, No.6, pp1128-1136, August 1995

[14] R Vidhyapriya , Dr P T Vanathi, " *Energy Efficient Adaptive Multipath Routing for Wireless Sensor Networks*", IAENG International Journal of Computer Science, 34:1, Aug'2007.

[15] Li Layuan Li Chunling, "*The QoS-Based Routing Algorithms for High-speed Networks*", Print ISBN: 0-7803-6394-9, Pages: 1623 – 1628, vol.2, 2000, IEEE

[16] Ali Al-Dhaher, Tricha Anjali, Alexandre Fortin, "*Achieving Distributed Buffering in Multi-path Routing using Fair Allocation*", Print ISBN: 978-1-61284-465-7, ISSN : 2154-0357, Pages: 1 - 6, 2011, IEEE.

[17]. Li Layuan, Li Chunlin.,"*A routing protocol fordynamic and large computer networks with clustering topology"*, Computer Communications,1999.

[18] Keshav S. (1997), "*An Engineering Approach to Computer Networking: ATM Networks, The Internet, and The Telephone Network*", Addison-Wesley Longman, Inc., Harlow, England.

[19].A.Alies, Cisco white paper: ATM Networking, Cisco systems inc. May,1995.

[20].http://technet.microsoft.com/en-s/library/cc957852.aspx

[21]. ttp://superlinebroadband.com/services.html

[22] Sajal K. Das, A. Mukherjee, S. Bandyopadhyay, "*Improving Quality-of-Service in Ad hoc Wireless Networks with Adaptive Multi-path Routing*", Global Telecommunications Conference, 2000. GLOBECOM '00. IEEE , ISBN: 0-7803-6451-1, vol.1. pp. 261 - 265

[23] Li Layuan, "*A routing algorithmfor distributed optimal double computer networkJournal of computer science and Technology, 1987 ,2(2) : 92-98*

[24]. Eric W.M. WONG, Andy K.M. CHAN, Sammy CHAN, and King-Tim KO*, "Bandwidth Allocation for virtual Paths in ATM Networks with Dynamic Routing",*IEICE Trans.Communications, Vol.E83-B, No.3, March 2000.

[25]. Patrick P.C. Lee, Vishal Misra and Ruben Stein, ―*Distributed algorithm for secure multipath routing"*, International symposium on circuits and system, 23-26 May 2005, volume- 4, pp 3255-3258.

[26]. Alvin Valera, Winston K.G. Seah and SV Rao*,"Cooperative Packet* Caching and Shortest Multipath Routing in Mobile Ad hoc Networks‖, ISSN : 0-7803-7753-2, IEEE, 2003.

[27]. T. Anjali, A. Fortin, G. Calinescu, S. Kapoor, N. Kirubanandan, S. Tongngam, ―*Multipath Network Flows: Bounded Buffers and Jitter‖, in Proceedings of IEEE Infocom, San Diego, California, pp. 1–7, 2010.*

[28]. T. Anjali, A. *Fortin, S. Kapoor, ―Multi-Commodity Network Flows over Multipaths with Bounded Buffers‖, in Proceedings of IEEE International Conference on Communications, Cape Town, South Africa, pp. 1–5, 2010.*

[29]. A. Al-Dhaher, ―*Distributed Buffering in Multipath Routing‖, Dept. of Electrical and Computer Engineering, Illinois Institute of Technology, Chicago, Illinois, 2010*.

[30]. Kui Wu and Janelle Harms, ―On-Demand Multipath Routing for Mobile Ad Hoc Networks‖, Networks EPMCC 2001, Vienna, 20th – 22nd February, 2001

[31]. N. F. Maxemchuk, "Dispersity Routing in High-speed Networks,‖ Computer Networks and ISDN system 25, Page 645-661, 1993.

[32]. ATM Forum Technical Committee. Private Network-Network Interface Specification Version 1 .O (PNNI 1 .O), *ATM Forum*, March 1996.

[33]. Susmi Routray, —*An* enhanced genetic algorithm for dynamic routing in ATM networks‖, ISSN: 1817-3195, Vol. 16 No.2, pp [153 – 159], 2010.

[34]. Sharam Hekmat, "Communication Networks‖, ISSN 0894-8755, PragSoft Corporation, 2005.

[35]. David Wall ,—Internetworking Technologies Handbook: An Essential Reference for Every Network Professional‖, ISBN: 1-58705-001-3, Cisco Systems, 2000.

[36]. Swades De , Chunming Qiao and Hongyi Wu *"Meshed multipath routing: an efficient strategy in sensor networks"*, IEEE, ISSN**:** 1525-3511, vol.3, pp- 1912 – 1917, 2003.

[37]. E. Gafni and D. Bertsekas, *„„Distributed algorithms for generating loop free routes in networks with frequently changing topology*,‘‘ *IEEE Trans. Commun.*, vol. 29, no. 1, pp. 11--15, January 1981.

[38]. M.S. Corson and A. Ephremides, *„„A distributed routing algorithm for mobile radio networks*‟‘ in *Proc. IEEE MILCOM ‟89*, Oct. 1989.

[39]. S. Vutukury and J.J. Garcia-Luna-Aceves, ‗‗*Mdva: a distance-vector multipath routing protocol*‘‘ in *Proc. IEEE INFOCOM ‟01*, vol. 1, pp. 557—564, 2001.

[40]. S. Lee and M. Gerla, *„„Aodv-br: Backup routing in ad hoc networks*,‘‘ in *Proc. IEEE WCNC ‟00*, Sept. 2000.