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Cell delay minimisation by using enhanced genetic algorithm in atm networks

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ABSTRACT

Wireless ATM is upcoming as solution in the era of telecommunication. As wireless ATM gaining popularity is essential to find the subsequent use of ATM network . One of the major issue is the optimized usage of bandwidth for ATM networks. In this paper an Enhanced Genetic Algorithm (EGA) algorithm approach based solution is proposed for optimization of bandwidth through dynamic routing in ATM network. In this paper non-traditional optimization technique for EGA has been approached. The results obtained thus prove that EGA can algorithm solves the purpose for obtaining optimized bandwidth and minimization cell delay. Due to it many attractive business applications like high speed LAN interconnection, teleconferencing would become feasible. A comparative study of the selection mechanisms in GA and listed the best selection mechanism. It is a new technique which improves the efficiency of the EGA.

Introduction

ATM is a connection oriented transfer mode based on asynchronous time division multiplexing. ATM is considered improve the flexibility of traffic performance [1]. The ATM technique is connection oriented, where the source initially declares a set of traffic parameters to describe its traffic and generates its traffic according to the declared parameters [25].In ATM, information is sent by a fixed size cells of 53 bytes , 5 bytes are used for header field and remaining 48 bytes are reserved for data field. In ATM the recurrence of cells delivered by an individual user may not be periodic. In this paper we explore the meta-heuristic based optimizing technique specifically EGA which can be used to optimize the ATM network [10,11,12]. There are many variations to EGA algorithm, the communication devices operate at different speeds [2]. Different traffic types with different traffic characteristics and different QoS requirements can exist with Virtual Path(VP) subnetworks within ATM Network[3] VP is a logical link between two nodes carrying the same type of traffic. VP networks [4, 5] are best suitable for utilizing the ATM networks. VP supports a large number of virtual connections, between ATM nodes [6]. To obtain the better network performance VPs network is formulated in the form of Optimization Routing Problem (ORP) [7]. Genetic Algorithm is a advance optimizing technique which can be used to optimize the ATM network. GA operations [13, 14] can be briefly described as Coding, Initialization, Evaluation, Reproduction, Crossover, Mutation and Terminating condition.

In this paper an enhanced GA approach is proposed, which quickly convergence from local optima that exists in GA and will overcome the limitation of GA. According to earlier research in the same field it has been realized that still many opportunities are possible by using EGA Algorithm. In this paper we have explored use of EGA for minimizing bandwidth optimization problem in ATM network.

Problem Description

Here we considered a ATM network model as a graph [18] G(N,L), N denotes switching nodes and L denotes the physical link connecting to each node [17]. Lij is the link between node i & j. The second order graph $G_L(N,P)$ where P denotes connection of the logical path . A network with seven switching nodes and ten physical links is considered (Fig.1). Two nodes are connected by one logical link and sharing the capacities of physical links connecting the nodes. The bidirectional path is created for connecting two nodes tomanaga the capacity requirement in the sum of the traffic demand in both directions and total paths will be N (N-1)/2. Here one VP sub-network is considered for(Fig.2.) carrying the same type of traffic with the same QoS requirement for the fixed VP subnetwork. Bandwidth allocation to each VP is based on the deterministic bandwidth allocation [23]. The capacity allocation to each VP is equaliy distributed .

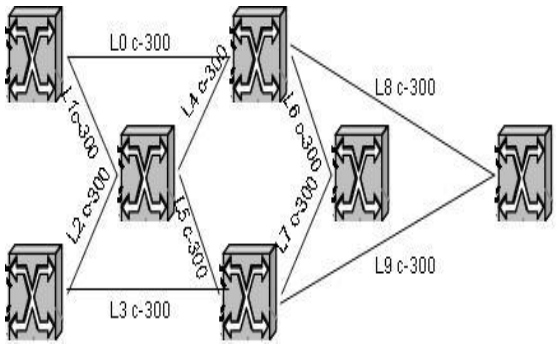

Fig.1. Network Model with Physical Link Capacity

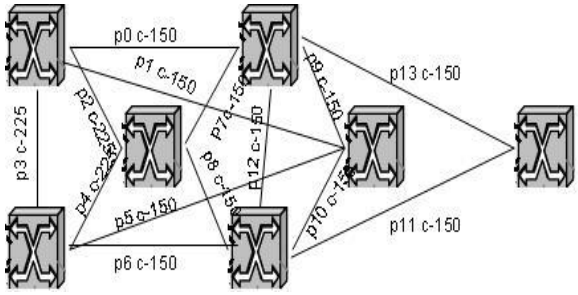

Fig.2. Network Model with Virtual Paths

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Objective Function

Here a dynamically reconfigurable network model [24] is considered that helps to meet the traffic demand. In ATM networks and to measure the network quality, Average cell delay is related to the average queue length which depends upon buffer overflow probability. [16]. Hence cell delay is also an indirect measure of cell loss probability.

Methodology

Genetic Algorithm Approach

Encoding Mechanism: Network configured on the basis of multi-parameter encoding mechanism [17]. Route table are created for all possible pairs of node combination. .Each route is identified by a route number in accordance to the row number in the route table toconstitute the configuration strings.

In the Initialization process the routes are selected randomly from the route table to form the configuration string. A pool of all configuration strings satisfies the given constraint . The size of the pool is fixed which is greater than the population size .The new generated strings are replaced by older strings. If in any generation, the population falls short of the size defined, the strings are chosen randomly from the group of Configuration string(CS).For *:* Evaluation, Based on the basis objective function the fitness of the CS are calculated. For designing Selection Mechanism: the average quality of the population is intended to improved by selection operator . the high-quality chromosomes provides a better chance to get copied into the next generation [14], [15]. Selection pressure characterizes the selection schemes. It is defined as the ratio of probability of selection of the best chromosome in population to that of an average chromosome. The selection techniques used in GA for the above problem are the roulette wheel selection, Truncation selection and Tournament selection mechanisms. In Crossover process for a single point crossover two strings are selected from the parent string and a randomly selected point. While from that point onwards the strings are interchanged. *The* mutation rate considered is 0.5% in this algorithm. *The procedure is repeated till the terminating condition is reached.*

Terminating condition is considered when average fitness is approximately equal to the maximum fitness or the algorithm orIt is repeated for a fixed number of generations. whichever condition is reached first is considered as the terminating condition.

ATM Nodes	0	1	2	3	4	5	6
0	0	20	10	20	10	20	10
1	12	0	13	40	12	16	14
2	13	16	0	15	11	20	12
3	10	15	14	0	18	8	16
4	15	18	12	10	0	16	10
5	10	20	10	20	10	0	15
6	12	18	15	18	15	18	18

Table 1 Traffic specification

Enhanced GA approach to Bandwidth Allocation

Memetic algorithm has been motivated by Dawkins' concept of meme(a unit of information that reproduces itself while people exchange ideas). Therefore, Memetic algorithms are termed as population based heuristic search techniques based on evolution to solve combinatorial optimization problem. Memetic algorithm is used to overcome the limitation of quick convergence from local optima. One variation of memetic algorithm integrates GA with local search technique and has been termed as Enhanced GA. Enhanced GA may be used in combination with genetic algorithms and local search algorithms to generate better solutions to optimization problems. The algorithm considered in this paper is Hill climbing algorithm. In hill climbing a better state is ever headed compare to the recent one. if there are no such states available then the algorithm terminates.

Results And Discussions

The traffic matrix for the nodes is given in Table1

The algorithms were applied to the network model (Fig. 2). The data of Table (1) has been considered for the evaluation of the algorithms and the flow capacities have also been listed in the network model By comparing the algorithms on the basis of ou our experimental results shows that EGA performs better than GA (Fig. 5). The best result obtained by GA is 6.16µsec and with MA is 5.77 µsec. So, for the above problem according to our experimental results Enhanced GA minimizes cell delay in ATM network

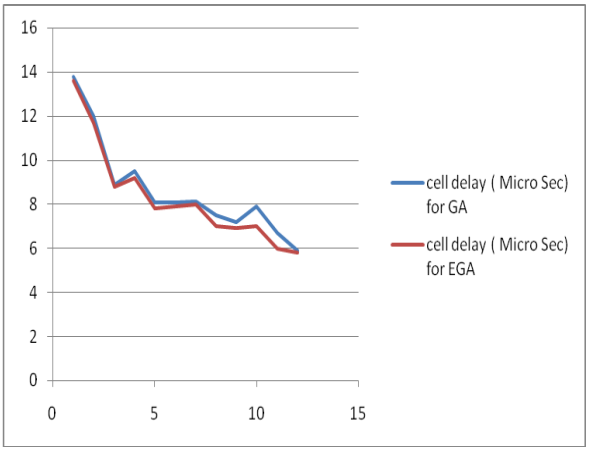

Fig 5: Comparison Chart for average Cell Delay using Genetic Algorithm((GA) and Enhanced Generic algorithm (EGA)

Conclusions

The ATM broadband ISDN is expected to support diffrent traffic and variable traffic patterns, A comparison of the selection techniques in GA and EGA has shown. Our experimental results show that EGA gives best average cell delay which is 5.77 µsec, according to the experimental network model. Thus optimized bandwidth is achieved. For future work EGA approach can be considered for the bandwidth optimization in wireless ATM network.

References

[21] D. Raychaudhuri and D. Wilson, "ATM-Based Transport Architecture for Multiservices Wireless Personal Communication Networks ", IEEE Journal On Selected Areas In Communications, vol 12, No 8, pp 1401 – 1413, Oct. 1994

[2] P. Wong and D. Britland, " Mobile Data Communication ", Artech House, 1993.

[3] S. Gupta et. al., "Routing in virtual path based ATM networks", IEEE GLOBECOM92, vol. 27,1993.

[4] K. I. Sato and I. Tokisawa, "Flexible Asynhronous Transfer Mode network utilizing virtual path", Proc. IEEE SUPERCOMM ICC 90, 831-838, 16-19 April 1990.

[5] J. L. Adams, "The virtual identifier and its application for routing and priority of connectionless and connection-oriented service", Int. Journal of Digital and Analog Cabled Networks, 257-262, 16-19 April'1988.

[6] S. Tanterdtid *et al*., "Optimizing ATM network throughput based on Virtual Paths concept by using Genetic Algorithm", Proc. IEEE ICIPS'97, Beijing, 1634–1639, 1997.
[7] S. W. Park and W. K. Tsai, "Optimal routing algorithm for high-speed (ATM) networks", Proc. IEEE INFOCOM'93, San Francisco, CA, USA, 3, 972–979, 28 March–1 April'1993.
[8] F. Y. S. Lin and K. T. Cheng, "Virtual Path assignment and virtual circuit routing", *Proc. IEEE GLOBECOM'93*, Houston, TX, USA, 1, 436–441, 29 November–2 December 1993.
[9] E. W. M. Wong et. al., "Bandwidth allocation and routing in virtual path based ATM networks", Proc. IEEE ICC/SUPER COMM'96, June 1996.
[10] S. Al-Sharhan et. al., "Learning-based resource optimization in asynchronous transfer mode (ATM) networks", Systems, Man and Cybernetics, Part B, IEEE Transactions on, Volume 33, Issue 1, Page(s):122 – 132, Feb. 2003.
[11] A. Vasilakos, et. al., "Optimizing QoS routing in hierarchical ATM networks using computational intelligence techniques", Systems, Man and Cybernetics, Part C, IEEE Transactions on, Volume 33, Issue 3, Page(s):297 – 312, Aug. 2003.
[12] DE. Goldberg, Genetic Algorithm in search , "optimization and machine learning", NewYork, Addison Wesley,1991.
[13] M. Srinivas, Lalit M. Patnaik, "Genetic Algorithms: A survey", IEEE, 1994.
[14] M. Srinivas, Lalit M. Patnaik, "Adaptive probabilities of crossover and Mutation in Genetic Algorithms", IEEE Trans. System,1994.
[15] D. R. Thompson, G. L. Bilbro, "Comparison of a genetic algorithm with a simulated annealing algorithm for the design of an ATM network", Communications Letters, IEEE Volume 4, Issue 8, Page(s):267 – 269, Aug. 2000.
[16] H. Pan and I. Y. Wang, "The bandwidth allocation of ATM through Genetic Algorithm", Proc. IEEE GLOBECOM'91, Phoenix, AZ, USA, 125–129,1991.
[17] N. Shimamoto, A. Hiramatsu and K. Yamasaki, "A dynamic routing control based on a Genetic Algorithm",*Proc.* IEEE ICNN'93, San Francisco, CA, USA,1123– 1128, 28 March–1 April 1993.
[18] S. Tanterdtid *et al*., "An optimum virtual paths network-based ATM network using the Genetic Algorithm", Proc. International Journal of Network Management, 8,158-169, 1998.
[19] Quintero Alejandro and Pierre Samuel, "A Memetic Algorithm for Assigning Cells to Switches in Cellular Mobile Networks", IEEE Communications Letters, Vol. 6, No. 11, pp 484 – 486, November 2002.
[20] P. Men and B. Freisleben, "Memetic Algorithms for the Traveling Salesman Problem," Complex Systems, 13(4):297-345. 2001.
[21] Peter Merz and Thomas Fischer, "A Memetic Algorithm for Large Traveling Salesman Problem Instances", In *MIC'2007 - 7th Metaheuristics International Conference*, 2007.
[22] V. Tirronen, F. Neri, "A Fast Randomized Memetic Algorithm for Highly Multimodal Problems", in Proceedings of EuroGEN 2007, 2007. pp. 27.
[23] Y. Sato and K. Sato, "Virtual path and link capacity design of ATM networks", IEEE journal on selected areas of communications, Vol. 9, No. 1, pp. 104 – 111, Jan 1991.
[24] M. Gerla et. al.," Topology design and bandwidth allocation in ATM nets,", IEEE journal on selected areas of communications, Vol. 7, No. 8, pp. 1253 – 1262, October 1989.
[25] Cc Xin Li,Yucheng Zhou, Georgi M.Dimirovski and Yuanwei Jing, "Simulated Annealing Q-Learning Algorithm for ABR Traffic Control of ATM Networks", American Control Conference ,pp:4462-4467 (2008)