Application of Stochastic Model on Routing Technique in Multi Class Queueing Network

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Abstract. In communication networks, the network size is growing hasty and the computation effort to finds a path between the source –destination pairs is increased massively. Multiple paths may exists between the source-destination nodes which direct that traffic load variations, overhead, response time take place. Routing plays a vital role on the performance and functionality of computer networks. Routing networks means identifying a path in the network that optimizes a certain criterion which is called as Quality of Service (QoS) routing and it is failure in the environment of large scale networks The storage and updating cost of routing procedure is prohibitive as the number of nodes in the network gets large. Stochastic techniques have assumed a prominent role in computer graphics, because of their success in modeling a variety of complex and natural phenomena. The usefulness of a particular stochastic model depends on both its computational advantages and on the extent to which can be adjusted to describe different phenomena. Network isolation is a key solution for improving the scalability problem in large networks. The main aim of isolation is minimizing the computation effort by maximizing the probability of having a path between source-destination pairs in the network. This paper deals with the specification and analysis of routing procedures that are effective for large hoard and promote packet switched computer networks. The new concept of stochastic isolation method introduced to resolve the scalability in Quality of Service routing algorithm. Graphical representation shows that how the new method improves the performance measure in terms of reduction in computational effort.

1 Introduction

Broadband of integrated service network is expected to support applications with Quality of Service requirements. The design of data network in integrated service is highly depends on the source-destination pair, which dispute for simplicity in the network central part and intricacy at the end hosts. This design principle enabled that the optimization performance within the network by computational policy. A communication network consists of a set of nodes that are connected by a set of links. A path has defined in the network where a collection of sequential communication links eventually connecting two nodes to each other. The process of finding and selecting the paths in the network is termed as routing function. A routing policy is a decision

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rule that selects which nodes to take next based on the current time and realize network link. The objective of routing technique is (i) distribute and searching the state information in optimal way of the network (ii) how to reduce the computational effort in searching for a path. The main drawback of all modern routing algorithms is in lack of ability to scale the large networks proficiently. In traffic pattern, the router allows to share the network congestion state previously examined by other connections sharing the same bottleneck link, which improves the throughput drastically. For such requirements, transition is to isolate the central part router function from the computational framework. The stochastic isolation method that dynamically changes network isolation according to traffic patterns in the network in order to minimize an objective function that reflects the computational effort involved in routing algorithm used in the network. Network isolation is the solution to enhancing the scalability in large networks. Network isolation decomposes a network into sub networks according to particular rules and considerably reduces the computational effort of routing. In this method, the probabilities used to partition the network correspond to the frequency of connection requests between every pair of nodes in the network. The stochastic isolation technique has reduces the computational effort in routing network and showed that which is effective and efficient for large scale routing network. The rest of the paper is organized as follows: Section 3 explain the concept of Qos route sharing resource. Section 4 describes the routing computational framework of packet switching network. Section 5 discusses stochastic isolation and introducing some notations. Section 6 explains the overhead in scalability techniques. Section 7 graphical representation discussed. Finally, section 8 concludes the paper.

2 Literature Survey

Broadband of integrated Scalability in communication network had been developed by Amitabh Mishra(2002). Ariel Orda et al (2002), has clearly explained a scalable approach to the partition of QoS requirements in unicast and mulitcast. Fang Hao et al (2002), had explained the scalable QoS routing performance evaluation of topology aggregation. P. Gupta et al (2006), has clearly envisaged the optimal throughput allocation in general access networks. W. Ching et al (2009), has analyzed the optimal service capacities in a competitive multiple-server queueing environment. |E. Leonardi et al (2005), had approached the Joint optimal scheduling and routing for maximum network throughput. X. Lin et al (2004), had analyzed an optimization based approach for quality of service routing in high-bandwidth networks. Orda et al (2003), had approached the pre-computation schemes for QoS routing. S. Sinha Deb et al (2003), had given a detailed explanation of a new approach to scale quality of service routing algorithms.

3 Quality of Service on Routing Update Resources

The role of a QoS routing policy is to compute a suitable path for the different types of traffic generated by the various applications, while maximizing the utilization of network resources. The implementation of these objectives requires the development of algorithms that find multi-constrained paths taking into consideration the state of the network and the traffic requirements namely, delay jitter, loss rate and available bandwidth. Routing decision is determined based on the network information available at the source. A packet flow has referred to as IP packet stream linked from a source to a destination with QoS in finite period. When a flow request arrives, there is routing algorithms that stipulate the routes to all known destination, which preserve the position of all the routes in the network. Recurring state is the main part in routing algorithms which updating the minimum distance of each router for all destinations. The nodes have to be update periodically by routing update before the time run out. For the services that have ensured the Qos guarantee for the entire period of flow, otherwise the flow request is starve. The main aim of QoS routing is to minimize the run time and has to reduce the impact on the run set-up time at least from the routing computation point of view. Consider a packet switching network with a source-destination pair [i, j]. Let $\mathrm{P}_{[i,j]}(\eta)$ denotes the set of paths determined at time η and $\mathrm{Z}^{\kappa}{}_{[i,j]}(\eta)$ signifies the set of links where $\kappa \in \mathrm{P}_{[i,j]}(\eta)$. The average time of the path κ for [i, j] is determined by $\Psi_{[i,j]}(t) = \min_{b \in \mathrm{Z}^{\kappa}{}_{[i,j]}} \{\mathrm{X}_b(t)\}$; $\mathrm{X}_b(t)$ represents the available capacity of link b at time t.

4 Routing Computational Framework

The basic component of Quality of Service routing framework is path selecting that can operate in a link state routing protocol environment where different information can be used in two different scales. The goal of routing computational framework is (i) to reduce the impact of flow setup time. (ii) to avoid user level re-attempt in heavily loaded network (iii) to select a route quickly in possible paths. The framework consists of three stages at different time scale: (i) First Round Path Communicating (FRPC) stage. (ii) Sorted Path Ordering (SPO) stage (iii) Definite Route Assortment (DRA) stage.

The First Round Path Communicating (FRPC) stage does preliminary determination of a set of possible paths from a source node to destination node. The Sorted Path Ordering (SPO) stage follows Markov process (selects the most recent states of all links available to each node) and filters it to provide a set of Quality of Service acceptable paths. Moreover, this phase order the routes from most to least acceptable paths which is obtained from list of FRPC stage. The Definite Route Assortment (DRA) stage follows that to select a definite route as swiftly as possible based on the pruned available paths from the SPO stage. The main advantage of this framework is that various distributed routing schemes can fit into this framework and multiple Quality of Service requirements be used.

4.1 Packet Routing Policy

In satellite, the communication sub network accomplishes communication among the network resources. In packet switching network, the message has wrecked into small segments and then transmitted through the network in the form of hoard and promote switching. A packet has transmitted from source node to destination node, which may be hoard in queue at any intermediate node for transmission and then promote to the next node. The selection of the next node is based on the routing policy. Routing policy has divided into two categories: Deterministic (Design phase) and Adaptive (Networks Operation). Adaptive policy plays a vital role for triumphant operation of networks and it describes the state of the network. A central node providing the routing information to all sub nodes in the network which computing the information directly.

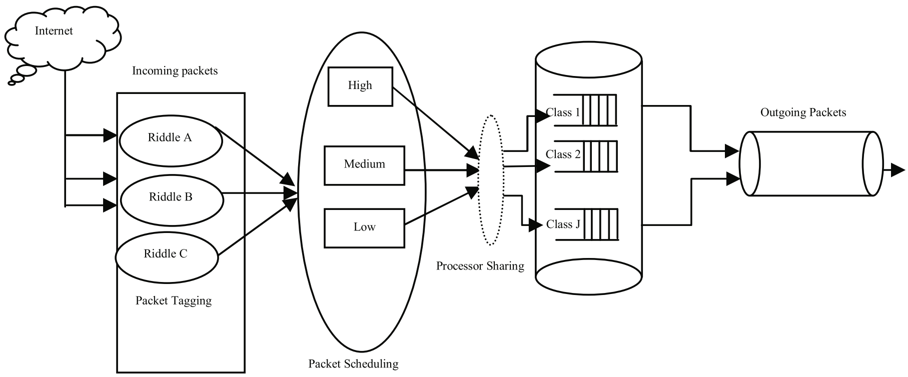

Fig. 1. Queueing Discipline in Packet Switching Network

5 Stochastic Isolation

Scalability Stochastic isolation technique is designed to partition the original network into a number of blocks which enhancing the scalability routing algorithm in large networks. In this method network is partition in a probabilistic manner that corresponds to the frequency of connection requests between every pair of nodes in the network. The main objective of stochastic isolation is to minimize the mean computational effort spent by the routing algorithms used in the network by maximizing the chance of selecting a source–destination pair in the same block of the partition. In particular, if the source-destination pair in the same block there must exist at least one path between every pair of nodes in the block, which is termed as irreducible. For low connectivity network, the partition is more difficult with irreducible blocks whereas easily constructed in high connectivity network. Thus, each block should consist of at least two nodes in order to have communication between them.

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5.1 Objective Function of Isolation Strategy

The objective is to minimize a quantitative measure for any network isolation structure in terms of the computational effort in routing. The mean computational effort in finding a path satisfy the constraints from a source node to destination node, averaged overall source-destination pairs, in a network of K nodes and Z links be $\Psi(\mathrm{K},\mathrm{Z})$. The objective function of computational effort is defined as

$$C(\mathrm{K},\mathrm{Z}) = \min\left[\bigcup_{i=1}^{N} P_i\, \Psi_i(\mathrm{K}_i,\mathrm{Z}_i) + (1-\bigcup_{i=1}^{N} P_i)\, \Psi(\mathrm{K},\mathrm{Z}) + P(K,Z)\right]$$

where P_i represents the probability that given a connection request when both source and destination nodes located in the same block, $P(K,Z)$ represents the isolation overhead per connection request, $\bigcup_{i=1}^{N} P_i\, \Psi_i(K_i,Z_i)$ represents the computational effort involved when both source and destination nodes located in the same block and $\left[1-\bigcup_{i=1}^{N} P_i\right]\Psi(K,Z)$ represents the computational effort when both source and destination nodes located in the different blocks.

Let P_{ij} be the conditional probability that given a connection request from source node ‘i’ to the destination node ‘j’. P_{ij} is defined as follows:

$$P_{ij}(\omega) = \frac{\eta_{ij}(\omega)}{\sum_{\substack{i,j\in N \\ i\neq j}} \eta_{ij}(\omega)}$$

where $\eta_{ij}(\omega)$ denotes the number of times source node i has requested a connection to destination node in the last ω time unit.

$P_{ij}(\omega)$ will be more accurate, as the time unit ω increases $\underset{\omega\to\infty}{lt} P_{ij}(\omega) = \mathrm{P_{ij}}$

$$P_{ij}(b) = \frac{C^{N-2}_{n_{b-2}}}{C^{N}_{n_b}} = \frac{\dfrac{(N-2)!}{(\mathrm{b}-2)!\,(\mathrm{N}-2-\mathrm{b}+2)!}}{\dfrac{(\mathrm{N})!}{(\mathrm{nb})!\,(\mathrm{N}-\mathrm{nb})!}} = \frac{(\mathrm{n_b}-1)(\mathrm{n_b})}{(\mathrm{N}-1)\mathrm{N}}$$

where n_b denotes the number of nodes in block b and N denotes the number of nodes of the network.

6 Scalability Techniques Overhead

The most important constraint on isolation is partition overhead. There are two major types of overhead are routing update reduction and route computation reduction. The routing update reduction provides the information continuously updated to the network nodes through routing information. Additionally frequent updated routing leads to a better routing performance in the network and consumes more network bandwidth and processing power. Reduction of routing update frequency in two ways:(1) searching for appropriate routing update trigger policies to provide controllable update frequency and predictable accuracy, (2) designing appropriate routing algorithms to minimize the impact of stale routing information.

The route computation reduction is essential for achieving high-quality routing performance and scalability. Route pre-computation and path catching are the two major approaches in order to reduce route computation. Route pre-computation is used to compute and store the paths to all destinations before the request that leads that minimize the request operations. Moreover, that it helps to compute multiple paths to the same destination nodes and balance the traffic load. Path catching avoids computing the same path again.

7 Graphical Representation

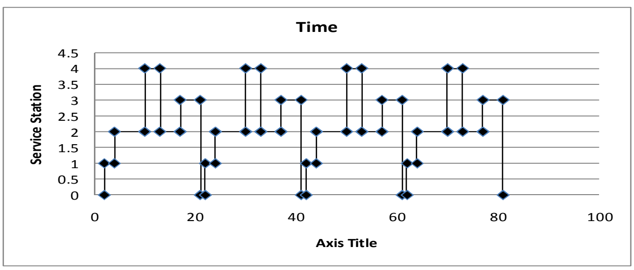

Fig. 2. Service Load Distribution

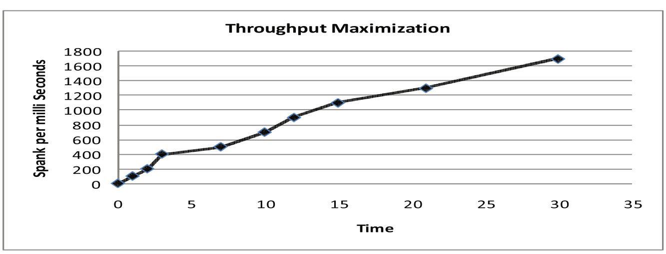

Fig. 3. CPU Utilization

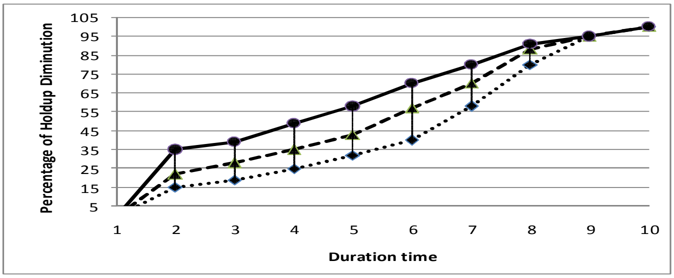

Fig. 4. Dispersion Factor

8 Conclusion

In this paper, The Quality of Service routing is a main component of a computational framework. The scalability network is the challenging issue in the environment of large networks. In this paper, a new concept has introduced for isolation using stochastic isolation to reduce computational effort to find a path. The stochastic isolation technique is to maximizing the scalability and minimizing the complexity in large networks. Graphical representation shows that the stochastic isolation speed up the routing functions.

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