

Residual Bandwidth as Localized QoS Routing Metric

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Abstract— Quality of service (QoS) routing has been proposed for supporting the requirements of network applications and satisfying connection constraints. A large amount of information needs to be exchanged periodically among routers. Therefore, in order to satisfy such requirements localized QoS routing algorithms have been proposed. This is where source nodes make routing decisions based on statistics collected locally. Using local information for routing avoids the overheads of exchanging global information with other nodes. In this paper we present a localized bandwidth-based QoS routing (BBR) algorithm, which relies on residual bandwidth that each path can support to make routing decisions. We compare our scheme with Credit Based Routing (CBR) and the commonly used global WSP routing scheme under different traffic loads and network topologies. We demonstrated through simulation that our scheme performs better than CBR and outperforms the WSP scheme in some network topologies, even for a small update interval of link state.

III. INTRODUCTION

The concept of QoS routing has emerged from the fact that routers direct traffic from source to destination, depending on data types, network constraints and requirements, to achieve network performance efficiency. It has been introduced to administer, monitor and improve the performance of networks. A lot of QoS algorithms [1] [2] [3] [4] are used to maximize network performance by balancing traffic distributed over multiple paths. Its major components include bandwidth, delay, jitter, cost, and loss probability in order to measure the end users' requirements, optimize network resource usage and balance traffic load.

The above algorithms, which are source routing algorithms, depend on global network state information in order to make routing decisions. The global QoS network state needs to be exchanged periodically among routers. Such high levels of exchange may incur large communication and processing overheads.

Localized QoS routing [5] [6] is proposed to achieve QoS guarantees and overcome the problem of using global network state information. Under such an approach, a source node makes its own routing decisions based on the information collected by monitoring the traffic generated from itself. Localized QoS routing does not need the global network state to be exchanged among network nodes because it infers the network state and avoids all the problems associated with it. In localized QoS routing each source node is required to determine a set of candidate paths to each possible destination which is not the intention of this paper. More information about candidate path selection methods can be found in [7] [8].

This paper proposes a bandwidth based routing (BBR) which is a simple localized QoS routing algorithm that relies

on average residual bandwidth on the path in order to take routing decisions. We study other localized QoS routing schemes: firstly, the localized Credit Based Routing (CBR), proposed in [6] [9]; and the global QoS routing scheme Widest Shortest Path (WSP), proposed in [1].

IV. RELATED WORK

A. PSR

The Localized Proportional Sticky Routing (PSR) algorithm [5], which was the first localized QoS routing scheme. In this, each source node needs to maintain a set of candidate paths R . A path based on flow blocking probability and the load is proportionally distributed to the destination among the predefined paths. In PSR there are minimum hop (minhop) paths R^{\min} and alternative paths R^{alt} , where $R = R^{\min} \cup R^{alt}$. The PSR algorithm operates in two stages: proportional flow routing and computation of flow proportions. PSR proceeds in cycles of variable length, which form an observation period. Incoming flows are routed during each cycle along a path r , selected based on a flow proportion from a set of eligible paths R^{alt} . Initially, all candidate paths are eligible paths and each of them is associated with an adjustable variable called the maximum permissible flow blocking parameter γ_r , which gives the maximum number of flows before the path becomes ineligible. For each minhop path, γ_r is set to Y , which is a configurable parameter, whereas alternative path γ_r is dynamically adjusted between 1 and Y . When all paths become ineligible, a cycle is completed and a new one is started after all parameters are reset. An eligible path is selected to route the flow based on its flow proportion. At the end of the observation period, a new flow proportion α_r is computed for each path in the candidate path set based on its observed blocking probability b_r . After each observation period the minhop paths flow proportions are adjusted to equalize their blocking probability (α_r, b_r). For the alternative paths, the minimum blocking probability among the minhop paths b^* is used to control their flow proportion. That is, for each $r \in R^{alt}$, if $b_r < \Psi b^*$, $\gamma_r = \min(\gamma_r + 1, y)$. If $b_r > b^*$, $\gamma_r = \max(\gamma_r - 1, 1)$, where Ψ is a configurable parameter to limit the 'knock-on' effect under system overloads. Note that $\gamma_r \geq 1$ ensures that some flows are routed along alternative paths to measure their quality [5] [6].

The PSR simulation results prove that it is simple, adaptive,